12 May 1969

Materiel Test Procedure 2-4-001
Yuma Proving Ground

U.S. ARMY TEST AND EVALUATION COMMAND
ENVIRONMENTAL TEST PROCEDURE

DESERT ENVIRONMENTAL TESTING OF WHEELED AND TRACKED VEHICLES

1. OBJECTIVE

The purpose of this Materiel Test Procedure is to determine the operating, maintenance, and durability characteristics of wheeled and tracked vehicles when operating in various types of desert terrain.

2. BACKGROUND

Each major item conceived and developed, and produced for the Army must be capable of performing under various environments of the world including the varying desert conditions (hot-dry during daytime and temperature drops at nighttime), which may have a significant effect on the performance characteristics of the test item. Many items of materiel do not meet the criteria for adequate performance in the desert environment. These criteria are concerned with operating, maintenance, durability and reliability characteristics of the test item and the effects of desert environmental conditions on the physical characteristics of the test item.

3. REQUIRED EQUIPMENT

a. Combat equipment and supplies for combat vehicles.
b. Photographic facilities including cameras and film.
c. High density payloads (actual or simulated) for transport vehicles.
d. Test vehicles maintenance package and Technical Manuals.
e. Maintenance facilities as required.
f. Applicable laboratory facilities as required.
g. Calibrated engine tachometer and recording equipment.
h. Calibrated fuel pressure gage.
i. Thermocouples, pressure gages and recording equipment as required.
j. Knock sensing instrumentation as required for pressure sensing and vibration sensing.
k. Oscilloscope and oscilloscope camera and film.
l. Specification fuels of known octane rating as follows:

   a) Combat gasoline MIL-G-3056, Type 1, Ref N.
   b) Referee grade gasoline MIL-G-46015, Grade 1, Ref AD.
   c) Automotive gasoline Federal Spec, VV-G-76, Class A, Ref D.

m. Primary reference fuels (iso-octane and n-heptane) in steps of 2.5 octane ratings between 60 and 100 octane.

n. Severity reference fuels (iso-octane, n-heptane, and di-isobutylene) in steps of 2.5 octane (research method) between 75 and 100 octane.

o. A series of full-boiling-range reference fuels in steps of one or two octane numbers (research method) between 86 and 105 octane prepared from test gasoline established as standards by Coordinating Research Council Inc., (CRC).

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p. Power-absorption trailer or dynamometer for controlling load and speed of test vehicle.

q. Specific road courses as described in each test.

r. A flow-tested carburetor if available.

s. Soak shelters as required.

t. Fuel blending facilities capable of storing, cooling, blending, and analyzing specification fuels and high and low vapor fuel samples.

NOTE: The above facilities normally provided by the chemical unit of the test support branch should have analytical capabilities to determine fuel Reid vapor pressure (RVP), distillation curves, and vapor-liquid (V/L) ratio at specific temperatures.

u. Fuel sampling equipment, including sample containers, siphon apparatus for collecting samples by water displacement, and means of refrigerating samples and bottles.

v. Means of transporting fuels and fuel samples (55 gallon drums, etc.)

w. Meteorological station capable of obtaining

a) Temperature
b) Windspeed and direction
c) Relative humidity
d) Barometric pressure
e) Solar radiation

x. Referee grades of lubricants as required.

y. Vehicle similar to vehicle under test (pilot vehicle).

z. Personnel dust protection equipment, such as dust masks and goggles.

aa. Facilities and equipment for collecting, drying, weighing, and measuring dust accumulations and samples.

ab. Instrumentation, such as a piezoelectric transducer sensor, to measure air flow restriction across the air cleaner, when required.

4. REFERENCES

A. MTP 9-4-001, Desert Environmental Test of Construction, Support, and Service Equipment.
B. MTP 10-4-001, Desert Environmental Test of General Supplies and Equipment
C. USATECOM Pamphlet 700-700, USATECOM Materiel Test Procedures
D. MTP 2-2-500, Vehicle Characteristics
E. MTP 2-2-501, Amphibious Vehicle Characteristics
F. MTP 2-2-502, Inspections (Automotive)
G. MTP 2-2-505, Preliminary Operation
H. MTP 2-2-508, Safety Evaluation (Automotive)

I. AMC Regulation 385-12, Verification of Safety of Materiel from Development through Testing and Supply to Disposition.
J. AR 705-15, Operation of Materiel under Extreme Conditions of Environment.
K. MTP 2-2-503, Maintenance.
L. MTP 2-2-701, Fuels and Lubricants.
M. Aberdeen Proving Ground Standard Procedure for the Automotive Engineering Laboratory Division, Procedures for Determining the Octane Requirement of Military Engines.
N. Military Specification MIL-G-3056, Gasoline, Automotive, Combat
O. Federal Specification VV-G-76, Gasoline, Automotive
P. MTP 2-2-603, Vehicle Fuel Consumption.
Q. MTP 2-2-607, Engine and Power Train Cooling Systems (Vehicle)
R. MTP 2-2-608, Braking.
S. MTP 2-2-604, Drawbar Pull.
T. Military Specification MIL-A-62048, Air Cleaners, Automotive: Heavy-Duty, Dry-Type (for Internal-Combustion Engines).
U. MTP 2-2-704, Tires.
V. MTP 2-2-619, Off-Road Vehicle Mobility Test
W. MTP 2-2-506, Durability Testing of Wheeled Vehicles
X. MTP 2-2-507, Durability Testing of Tracked Vehicles
Y. Test Capabilities at Yuma Proving Ground, Yuma Proving Ground, USATECOM, AD no. 824116.
Z. MTP 2-2-615, Security from Detection (Vehicles).
AA. MTP 2-2-803, Human Factors Engineering (Vehicles).
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5. SCOPE

5.1 SUMMARY

This MTP describes the following tests to be performed on wheeled and tracked vehicles during desert environmental tests:

a. Performance Tests - A study to determine how the vehicle performs under desert environmental conditions consisting of the following:

1) Octane Requirements Tests - An evaluation of the minimum octane rating the test vehicles gasoline can be without causing knock.
2) Fuel Vapor Handling Capability - An evaluation of the test vehicles resistance to vapor locking and other types of poor engine performance associated with premature vaporization of fuel in the fuel system.
3) Compatibility with Specification Grades of Fuels and Lubricants - An evaluation of the effect of desert environmental conditions on the test vehicle specified fuels lubricants, hydraulic fluids and related materials.
4) Fuel Consumption Tests - An evaluation of vehicle fuel consumption under desert environmental conditions.
5) Engine Cooling System Tests - An evaluation of cooling capabilities of the vehicle engine desert environmental conditions.
6) Braking Adequacy - An evaluation of the braking capabilities of the vehicle under desert environmental conditions.
7) Drawbar Pull Tests - A test to determine the tractive effort of the vehicle under desert environmental conditions.
8) Air Cleaner Adequacy Tests - A test to determine the adequacy of the air cleaner to remove damaging dust particles from combustion air of the vehicle engine.

b. Mobility Tests - A study to determine the effects of desert terrain upon the test vehicles mobility consisting of the following:

1) Sand Mobility Tests - A test to determine sand traversing capability of the test vehicle.
2) Desert Cross - Country Mobility Tests - A test to determine the vehicles ability to traverse the various types of desert terrain for a specified number of miles.
3) Durability Test - A test to determine the vehicle ability to traverse all types of terrain and road conditions for a specified number of miles.

c. Exposure and Storage Tests - A test to determine the deterioration effects of the desert environment on the test vehicle.

d. Maintenance Tests - A test to determine the maintenance requirements of the test vehicle under desert environmental conditions.

e. Security from Detection - A test to determine the test vehicles susceptibility to detection under conditions encountered in various parts of the desert.

f. Human Engineering - A test to determine the compatibility of man and the vehicle under desert conditions.

g. Safety - A test to determine if the desert environmental conditions have any effects on vehicle safety.

5.2 LIMITATIONS

This procedure is limited to the field testing under desert environmental conditions, of wheeled and tracked vehicles except those items, intended for sheltered environments, warehouse lift trucks, construction and rail equipment.

These procedures are not intended to test vehicle components such as collective protection systems and tank stabilization systems which are tested in other Desert Environmental Materiel Test Procedures.

6. PROCEDURES

6.1 PREPARATION FOR TEST

6.1.1 Initial Inspection

a. Visually inspect the test items upon receipt at the test site in accordance with MTP 2-2-502.

b. Repair or replace parts to remedy all significant deficiencies found and record such deficiencies.

c. Photograph all deficiencies.

6.1.2 Preliminary Operation

All test vehicles which have not been operated previously shall be subjected to the procedures described in MTP 2-2-505.

6.1.3 Vehicle Mechanical Inspection Tests

Subject the test vehicle to the initial inspection procedures as described in MTP 2-2-502 ensuring that lubricants which are appropriate for operation in the desert hot-dry environment replace the vehicles existing lubricants.

6.1.4 Vehicle Characteristics

a. Prior to test determine the vehicle characteristics in accordance with MTP 2-2-500.

b. Compare each test item with all previously published descriptions and record any differences.

6.1.5 Testing

The project engineer shall schedule the tests required by the approved test plan so that as many types of data will be recorded one time as can be obtained with the personnel, facilities, and equipment available and without interference with the objectives of the test.

6.1.6 Safety

The project engineer shall ensure the following:

a. Reasonable protection for test personnel against sunstroke, heat exhaustion, and sunburn.

b. Indoctrination of test personnel on local hazards and suggested precautions by local safety personnel.

6.1.7 Operating Mode

The project engineer shall ensure the following:

a. That all test procedures are performed with the test item operated in the normal operating mode.

b. Discourage all efforts to abbreviate prescribed operations or to discard inconvenient combat supplies, payload, or vehicle equipment.

6.1.8 Maintenance

The project engineer shall ensure that the test item's maintenance package and sufficient quantities of the prescribed maintenance supplies are available at the test site to enable testing to proceed.

6.1.9 Performance Tests

6.1.9.1 Octane Requirements

Ensure that the following has been accomplished prior to conducting the octane requirements tests

a. The test vehicle and engine have been proven to be in good mechanical condition.

b. The test vehicle engine has accumulated combustion chamber deposits during a minimum of 30 hours of operation.

c. Ignition timing is set at the level specified by the manufacturer for all speeds between maximum-torque and governed speed.

d. The governor has been rendered inoperative at the governed speed to allow for antiknock tests at the governed speeds.

e. A flow tested carburetor which meets the manufacturers specifications has been installed.

NOTE: If a flow-tested carburetor is not available, the air fuel ratios of the installed carburetor shall be checked at the low speed and high speed ends of the speed range.

f. The following instrumentation shall be installed prior to test:

1) A calibrated tachometer to measure engine speed.
2) A fuel pressure gage at the carburetor fuel inlet at approximately the same level as the fuel line connection.
3) Thermocouples to measure and record the following temperatures:

   a) for an air-cooled engine:

      (1) Carburetor inlet air.
      (2) All spark plug gaskets.
      (3) Two positions in the cooling air stream ahead of each bank of cylinders.
      (4) Engine oil sump.

   b) For a liquid cooled engine:

      (1) Carburetor inlet air
      (2) Oil sump
      (3) Coolant leaving the engine

4) Detonation sensors, when required, to measure engine knock.

NOTE: Engine knock may be detected by pressure or vibration sensing instruments.

g. Pressure-sensing instruments (piezoelectric transducers) mounted on modified spark plugs are the preferred form of sensor. The sudden increase of combustion chamber pressure which characterizes engine knock can usually be distinguished from the gradual increase of pressure which characterizes normal combustion.

h. Sperry magnetostriction detonation sensors, or equivalent vibration detection devices, are sometimes used for knock detection, particularly on air-cooled engines. The greater rigidity and mass of liquid-cooled engines usually limit the usefulness of these sensors with such engines.

1) For pressure-type sensors: spark plugs modified for the mounting of piezoelectric transducers.
2) For vibration-type sensors:

   a) For air-cooled engines: mounted on each cylinder perpendicular to the top of the piston and as far as possible from the spark plugs.
   b) For liquid-cooled engines: mounted along the cylinder heads perpendicular to the tops of the piston and as far as possible from the spark plugs.

NOTE: The exact number of sensors will depend on the length of the cylinder head, but generally one pickup will be installed for each two cylinders.

i. Install an auxiliary fuel system to introduce test fuels from 5-gallon containers. The vehicle fuel tank supply shall be disconnected during the octane requirements tests.

NOTE: 1. The auxiliary system shall be planned with care to avoid changing fuel transfer pressures.
2. Fuel systems using fuel injection pumps shall be modified to reroute bypass fuel so as to prevent mixing of test fuels.

6.1.9.2 Fuel Vapor Handling Capability

Ensure that the following has been accomplished on the test vehicle prior to conducting the fuel vapor handling capacity tests:

a. Inspection timing shall have been set at the level specified by the manufacturer.
b. Spark plugs are not worn or pitted or badly gapped.
c. Coolant thermostat is operating correctly.
d. Throttle and throttle control are operating.
e. Proper type and amount of lubricants and coolant are in the test vehicle.
f. Engine idling properly.
g. Power output normal.
h. Air cleaner clean.
i. Automatic transmission shift points are correct.
j. Vehicle has proper gross weight (full or combat load).
k. Tire pressure or track tension are correct.
l. Fuel system is in proper operating condition regarding the following:

1) Proper operation of vents
2) Carburetor adjustments and seating of needle valves
3) Carburetor fuel flow rate or fuel-air ratio
4) Fuel filters
5) Fuel pump output pressure
6) Fuel tank and line cleanliness
7) Absence of leaks

m. Install the following instrumentation:

1) Thermocouples to measure and record the following temperatures:

a) Fuel tank at fuel line
b) Fuel pump inlet
c) Carburetor input
d) Engine oil sump
e) Coolant temperature for liquid-cooled engines
f) Spark plug temperature for air-cooled engines

2) Speed measuring fifth wheel
3) Engine tachometer

4) Suitable timing devices
5) Oscillograph for acceleration data
6) Transducers to measure and record the following pressures:

a) Fuel pressure in the fuel tank at the fuel line
b) Fuel pressure at the carburetor inlet

n. Record the ollowing meteorological data during tests:

1) Ambient temperature
2) Relative humidity
3) Barometric pressure (absolute)
4) Wind speed and direction
5) Solar radiation

o. Prior to test determine the test vehicles fuel vapor handling capacity using the following procedures.

NOTE: In those instances where the test vehicle's designed temperature for a given Reid vapor pressure (Rvp) is not available during testing, use the equivalent Rvp, for the test items's critical vapor-liquid ratio, as determined from Figure 1, as follows:

1) Assume a test vehicle is designed to operate at ambient temperatures up to 125°F on a fuel produced under a specification allowing a maximum volatility of 9-psi-Rvp.
2) Assume also that the ambient temperature forecast for the desert field test of vapor handling capacity is 110°F, or 15° F less than the design maximum temperature.
3) Assume that the critical vapor-liquid ratio limiting the performance of most vehicles is about 20:1 (or V/L = 20).
4) Assume that the fuel system temperatures will vary one degree for each degree of change of ambient temperature.
5) In Figure 1, locate the temperature at which a 9-psi-Rvp fuel will show a vapor-liquid ratio of 20, i.e., at 136° F. Subtract 15° from that temperature, and find the point on the V/L = 20 curve which corresponds to the lower temperature (121°F).
6) From Figure 1, a blend which will have a volatility comparable to the specification fuels st 15°F cooler temperatures must have a V/L = 20 temperature of 121°F and an Rvp of approximately 11 psi.

6.1.9.3 Compatibility with Specification Grades of Fuels and Lubricants

Preparation for test shall be performed as described in MTP 2-2-701.

6.1.9.4 Fuel Consumption

Preparation for test shall be performed as described in MTP 2-2-603.

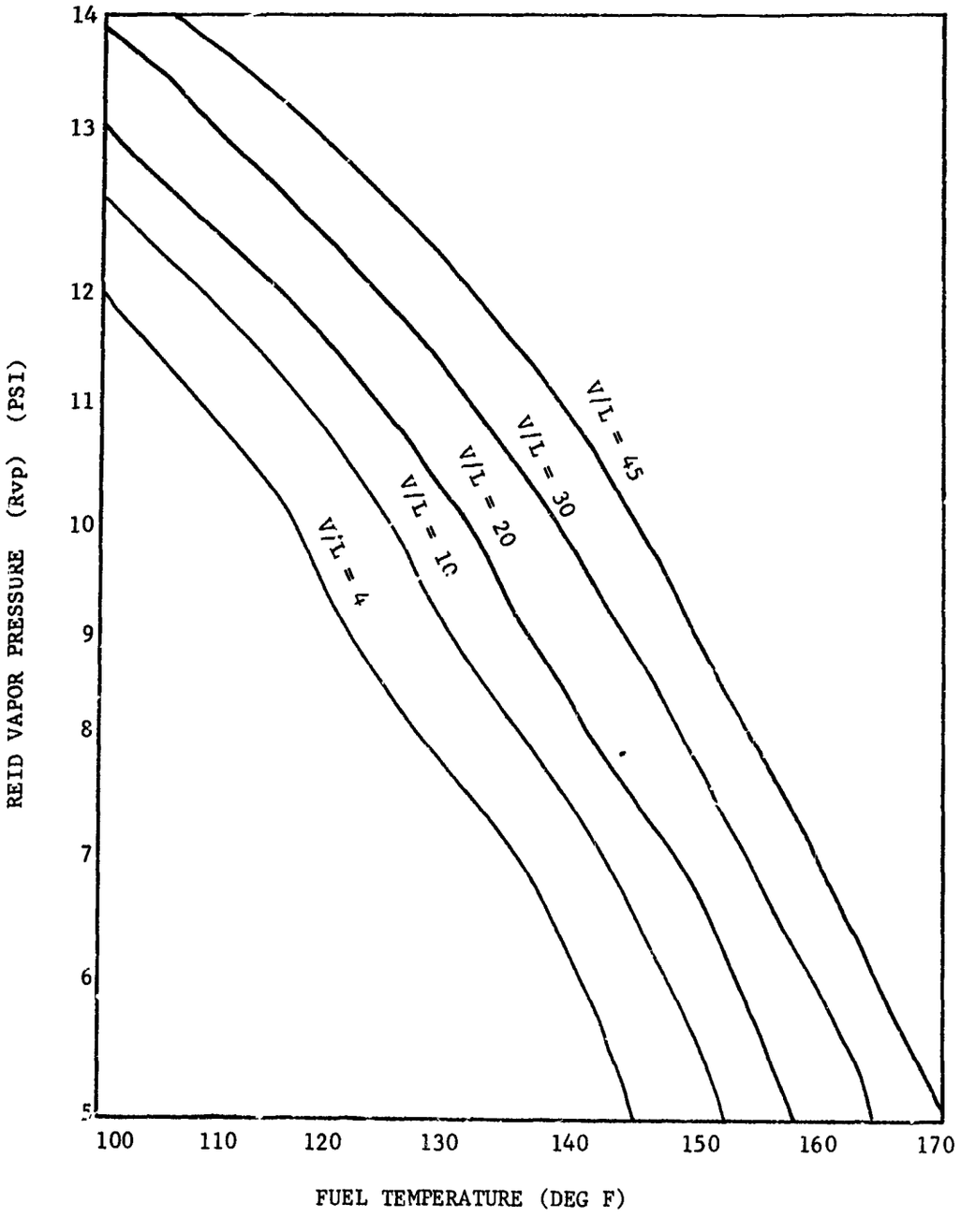

Figure 1. Relationships of Reid Vapor Pressure (Rvp) to Vapor-Liquid Ratio (V/L) and Temperature for a Typical Series of Test Fuel Blends

6.1.9.5 Cooling

Preparation for test shall be performed as described in MTP 2-2-607.

6.1.9.6 Braking

Preparation for test shall be performed as described in MTP 2-2-608.

6.1.9.7 Drawbar Pull

Preparation for test shall be performed as described in MTP 2-2-604.

6.1.9.8 Air Cleaner Adequacy

Ensure that the following has been performed prior to conducting air cleaner adequacy tests.

a. Verify that all interior surfaces of the test item, and the filter element, are clean. If the filter element is of the replaceable type, install a new element.

b. Install and calibrate instrumentation to measure air pressure differentials across the air cleaner.

c. Plan the installation carefully in accordance with MIL-A-62048 to avoid modifying the performance of the vehicle.

d. Calibrate the instrumentation under maximum air demand conditions, i.e., under as nearly full-throttle maximum engine speed conditions or at high speed stall conditions in the case of vehicles with torque-converter transmissions.

e. Install a counter to register engine revolutions.

6.1.9.9 Tire and Track Testing

Preparation for test shall be conducted as described in MTP 2-2-704.

6.1.10 Mobility Tests

6.1.10.1 Sand Mobility

Preparation for test shall be conducted as described in MTP 2-2-619.

6.1.10.2 Desert Cross Country Mobility

Ensure that the following has been performed prior to conducting desert cross country mobility tests:

a. Map out a test course across natural terrain at the desert proving ground or other desert test area that shall include the approximate mileage across each type of terrain as shown in Table I, and Table II as appropriate to the type of vehicle to be tested.

TABLE I. Mobility Tests - Mileage Requirements

Vehicle Class	Vehicle Type	Terrain Type: Mountains	Badlands and Hills	Fans and Washes	Desert Plains	Sand Dunes and Fields
Wheeled:						
	Tactical -					
	Combat	10	20	40	80	30
	Support	10	20	40	80	30
	Administrative	--	--	30	30	--
Tracked:						
	Tactical -					
	Combat	10	20	40	80	30
	Support	10	20	40	80	30
	Amphibious	5	15	30	40	30

TABLE II. Mobility Test - Example of Speed and Fuel Consumption Data Presentation

Course	Traverse	Mileage (miles)	Operating Time (hours)	Effective Speed (mi/hr)	Fuel Consumption (Gal/Hr)	Fuel Consumption (mi/Gal)	Remarks
Mountains	1	5.2	1.72	3.1			Immo 1 and 2
	2	5.3	1.92	2.8			Immo 3.4 and 5
	3	2.3	1.20	1.9			Immo 6 - 11, Traverse cut short
	4	2.7	0.95	3.0			Immo 12 - 14, Traverse cut short
				2.9	0.57	1.7	Eff speed based on trav 1 and 2, fuel to term on trav 3
Badlands/ hills	1	15.7	2.82	5.6			Immo 15
	2	17.2	3.43	5.0			Not Immo
	3	16.3	2.90	5.6			Immo 16
	4	17.5	3.15	5.6			Not Immo
				5.4	0.44	2.4	
Fans/washes	1	18.3	2.12	8.6	(time to failure		Front axle failed (EPR 23)
	2	7.4	0.80	9.3			
	3	16.9	1.83	9.2			
	4	18.5	1.95	9.5			
	5	17.6	1.80	9.8			
				9.3	0.42	3.9	

Key-
Immo = Immobilized
Trav = Traverse
Eff = Effective

NOTE: Figure 2 illustrates the desert terrain types considered. Appendix A describes these terrain types in terms of physiography and typical surface conditions.

b. Instrument the test vehicle with an external odometer not attached to the vehicle's wheels.

6.1.10.3 Durability Tests

Preparation for durability tests shall be conducted as described in 6.1.10.1 and Table III.

6.1.11 Exposure and Storage Tests

6.1.12 Desert Exposure and Storage

Preparation for desert exposure and storage shall be conducted as described in paragraph 6.1.3 and criteria of Table IV.

6.1.12.1 Security from Detection

Preparation for security from detection shall be conducted as described in MTP 2-2-615.

6.1.13 Human Engineering

Preparation for human engineering tests shall be conducted as described in MTP 2-2-803.

6.2 TEST CONDUCT

6.2.1 Performance Tests

6.2.1.1 Octane Requirements

Determine the test vehicle's octane requirements, under various operating conditions as follows:

a. Road-Load Acceleration

1) Warm up the engine, using a specification fuel, by operating at high speed with full throttle, until temperature stabilization is achieved, and record the following:

a) Specification fuel used
b) Fuel octane
c) Fuel pressure
d) Stabilization temperature at all instrumented points

Figure 2. Ten Types of Terrain Comprising All Worlds Desert Areas

TABLE III. Desert Durability Test Mileages for Wheeled and Tracked Vehicles

Type of Vehicle Wheeled Vehicles	Recommended Minimum Mileage	Miles per Cycle	Paved	Truck Gravel Course	Tank Gravel Course	Truck Hill Course	Tank Hill Course	Level Cross-Country Courses	Sand Dunes & Plains	Remarks
Group I Tactical Trucks	20000	2500	250	500	250	250	-	1000	250	Cycle 2, 4, 6 with towed load Cycle 8 without payload
Group II Truck Bodies, Equipment	7500	2500	250	500	250	250	-	1000	250	
Group III . A. LT. Wt. Low Mileage Sprung Trucks	4000	2000	200	400	200	200	-	800	200	10 percent of oper without payload
B. Lt. Wt. Low Mileage Unspring Trucks	2500	2500	200	400	300	300	-	1000	300	10 percent of oper without payload
Group IV High Flotation Vehicles	2000	2000	100	200	100	400	-	800	400	10 percent of oper without payload 10 percent with appropriate towed load
Group V Amphibious Vehicles	4000	2000	200	200	200	200	-	700	300	30 hours water operation 10 before, during and after test miles.
Group VI A Fire Trucks	2500	2500	250	500	250	250	-	1000	250	
Group VII Commercial Trucks, Busses, Cars	20000	5000	2000	2000	750	-	-	250	-	
Group VIII Armored Cars	15000	2500	250	500	250	250	-	1000	250	

TABLE III. Desert Durability Test Mileages for Wheeled and Tracked Vehicles (Concluded)

Type of Vehicle	Recommended Minimum Mileage	Miles per Cycle	Paved	Truck Gravel Course	Tank Gravel Course	Truck Hill Course	Tank Hill Course	Level Cross-Country Courses	Sand Dunes & Plains	Remarks
Tracked Vehicles										
Group I										
Tanks and Self-Propelled Weapons	2500	1250	125	50	200	-	125	625	125	
Group II										
APC's, Cargo Carriers, Recovery Vehicles, Wreckers, Cargo Tractors	3000	1500	150	100	200	-	150	750	150	1 Cycle with applicable towed load. Six hours water operation for amphibious type vehicle.
Group III										
Combat Engr and Assault Vehicle	2500	1250	125	50	200	-	125	625	125	
Group IV B										
Military Construction Equipment	3000	1500	150	100	200	-	150	750	150	Not less than 1000 hrs total operation including Engineer tasks
Group V										
Amphibious Vehicle	2500	1250	125	50	200	-	125	625	125	
Towed Vehicles										
Group A										
Trailers Semi-trailers and Dollies	6000	1500	400	500	200	150	-	200	50	
Group B										
Trailer Bodies and Equipment	3000	750	200	250	100	75	-	100	25	
Group C										
Electronic Trailers and Semi-trailers	4000	1000	250	350	200	75	-	100	25	

TABLE IV. Checklist of Effects of Desert Exposure

Susceptible Components	Possible Defects	Destructive Tests	
		Qualities to Test	Specifications
Tires	Separation of tread (visible) Separation of bead (visible) Tread cracks exposing fabric Sidewall cracks exposing fabric		MIL-STD-1224
	Broken cords (not visible) Separation of cords (not visible) Separation of plies (not visible)	Hidden defects	MIL-T-12459, MIL-STD-1224
Gaskets (Nonmetallic)	Leaking Cracking (altered dimensions) Spread (altered dimensions)	Hardness, tensile strength	MIL-STD-417
Vibration Mounts (Rubber type)	Cracks (more than 1/8 inch deep) Set (deformed)	Hardness, tensile strength	MIL-STD-417
Bumpers and Chevrons (Rubber type)	Cracks (more than 1/8 inch deep) Chips or breaks Separation from forgings	Hardness, tensile strength	MIL-STD-417
Drive Belts	Cracks (more than 1/16 inch deep) Wear (fraying) Ply separation (1/4 inch or more)		
Weatherstripping	Stiffness, brittleness Shrinking, warping		

TABLE IV.(CONT'D) Checklist of Effects of Desert Exposure

Susceptible Components	Possible Defects	Destructive Tests: Qualities to Test	Destructive Tests: Specifications
Tarpaulins (Treated or untreated duck)	Tears (1 inch or longer) Broken threads (numerous) Fading (extreme) Leaking	Bending moment, Tensile strength, Water resistance	Fed Std CCC-C-419, Fed Std CCC-C-428
Flaps and Enclosures (Treated or untreated duck)	Tears (1 inch or longer) Eyelet or tie damage (more than 10% of total) Fading (excessive) Leaking	Bending moment, Tensile strength water resistance	Fed Spec CCC-C-419, Fed Spec CCC-C-428
Fabric Tops (Treated or coated)	Tears (1 inch or longer) Checking (excessive) Leaking	Bending moment, tensile strength, water resistance	MIL-C-22524, MIL-C-8135
Seats and Cushions (Treated or coated fabric)	Worn, threadbare Torn (showing padding) checked or cracked (excessive) faded (excessive)	Bending moment, tensile strength	MIL-C-22524 MIL-C-8135
Molded Plastic Electrical Devices	Cracking, warping, looseness, poor fits Insecure attachment Crazing	Dielectric strength	MIL-C-13940
Wire Insulation and Sheathing	Split (wire exposed) Brittleness	Dielectric strength	MIL-C-13940
Rotating Electrical Devices and Coils	Wire insulation brittle Brushes worn Commutator scratched	Dielectric strength	MIL-C-3785

TABLE IV. (Con'd) Checklist of Effects of Desert Exposure

Susceptible Components	Possible Defects	Destructive Tests	
		Qualities to Test	Specifications
Lamp Lenses (Molded plastic)	Cracked or broken Etched Haze Discolored	Luminous transmittance	ASTM D-1003
Glass Parts	Discoloration or loss of transparency Laminations separated (1/4 inch or more) Etching	Luminous transmittance	MIL-G-3787
Molded Elastomer Parts	Visible defects as described in MIL-STD-177	Functional properties	MIL-HDBK-149

NOTE: Suspend the acceleration test if any air-cooled engine spark plug gasket thermocouple registers an excessive temperature. A temperature above 525°F shall be considered excessive unless the engine manufacturer has established another limit.

2) Connect the detonation sensors, if applicable, to their recording equipment and verify their operability. Record the rating and location of detonation.

NOTE: 1. Suspend the acceleration test if the detonation rating is severe.
2. Detonation (knock) is rated as having "0", "A", "B" or "C" intensity, as follows:

a) "0" knock is the absence of any detectable detonation.
b) "A" knock is a barely detected detonation.
c) "B" knock is a distinct detonation producing oscilloscope pulse amplitudes no greater than pulses produced by valve closures.
d) "C" knock is a severe detonation producing pulses having amplitudes greater than those produced by valve compressors.

3) Select a gear ratio which will allow an engine acceleration rate as specified in the test plan. The acceleration rate should fall between 30 rpm/sec and 60 rpm/sec depending on the vehicle under test. If no gear ratio is capable of any suitable manner to obtain the required acceleration. Record the method used to obtain the required acceleration, the acceleration rate, and, when applicable, the loading method.

4) Record the following meteorological data:

a) Wet bulb temperature
b) Dry bulb temperature
c) Barometric pressure (absolute)

5) Accelerate the test vehicle with wide open throttle from minimum practical speed to maximum rated speed and record the following:

NOTE: Ease off on the throttle, if necessary, to prevent severe or prolonged knocking. An air-cooled engine cannot tolerate knocking for more than 30 seconds without severe damage.

a) Fuel pressure
b) Stabilization temperature at all instrumented points
c) Engine speed at which knock is detected
d) Engine speed at which knock disappears
e) Engine speed at each occurrence of knocking
f) Severity of each occurrence of knocking

6) Rapidly decelerate the test vehicle by braking.
7) Repeat steps 5 and 6.
8) Repeat step 7.
9) At the completion of step 8, perform the following:

   a) Switch to the highest octane rated primary reference fuel.
   b) Scavenge the fuel system by running the engine out of fuel twice.

NOTE: If a quick-disconnect hose is used, the hose may be disconnected until fuel pressure falls to zero, then reconnected, thus scavenging the fuel lines without stopping the engine. With a fuel-injected engine, the pressure cannot be allowed to drop; instead, run the engine three or four times as long as would be required to run a similar carbureted engine out of fuel.

   c) Record the following:

      (1) Test fuel used
      (2) Fuel octane

10) Repeat steps 4 through 8.
11) At the completion of step 10, repeat steps 9 and 10 using the highest rated severity reference fuel.
12) Repeat steps 9 and 10 using the primary reference fuel of step 9 having the second highest octane rating.
13) Repeat step 12 using the severity reference fuel of step 11 having the second highest octane rating.
14) Repeat steps 12 and 13 using decreasing octane rated gasoline until severe knock develops.

b. Road-Load Deceleration:

1) Warm up the engine, using a specification fuel, by operating at high speed with full throttle, using a loading device (dynamometer) to limit road speed to a safe figure, until temperature stabilization is achieved, and record the following:

   a) Specification fuel used
   b) Fuel octane
   c) Fuel pressure
   d) Stabilization temperature at all instrumented points

2) Connect the detonation sensors to their recording equipment and verify their operability.

3) Select a gear ratio in which the loading device (dynamometer) will decelerate the test vehicle as specified in the test plan. The deceleration rate should fall between 30 rpm/sec and 60 rpm/sec, depending upon the vehicle under test, when operated at full throttle.
4) Record the following meteorological data:

   a) Wet bulb temperature
   b) Dry bulb temperature
   c) Barometric pressure (absolute)

5) Decelerate the test vehicle from maximum rated speed to minimum rated speed, at full throttle, and record the following:

   a) Fuel pressure
   b) Engine temperature

NOTE: Suspend the deceleration test if any air-cooled engine spark plug gasket thermocouples register an excessive temperature Unless otherwise stipulated by the engine manufacturer, a temperature of 525° F. shall be considered excessive.

   c) Engine speed at which knock is detected
   d) Engine speed at which knock disappears
   e) Engine speed at each occurrence of knocking
   f) Severity of each occurrence of knocking

NOTE: Suspend the deceleration test if the detonation rating is severe, or if the spark plug thermocouples of an air-cooled engine register an excessive temperature.

6) Stabilize the engine temperature by operating the vehicle at fuel rated engine speed.
7) Repeat steps 5 and 6.
8) Repeat step 7.
9) At the completion of step 8, perform the following:

   a) Switch to the highest octane rated second specification fuel.
   b) Scavenge the fuel system by running the engine out of fuel twice or as indicated in the NOTE of paragraph 6.2.1.1.a.9.
   c) Record the following:

      (1) Test fuel used
      (2) Fuel octane

10) Repeat steps 4 through 8.
11) At the completion of step 10, repeat steps 9 and 10 using the highest rated severity reference fuel.

12) Repeat steps 9 and 10 using the specification fuel of step 9 having the second engines octane rating.
13) Repeat step 12 using the specification fuel of step 11 having the second highest octane rating.
14) Repeat steps 12 and 13 using decreasing octane rated gasoline until severe knock develops.

c. Full Load, Full Throttle:

1) Warm up the engine, using a specification fuel, by operating at high speed with full throttle until temperature stabilization is achieved and record the following:

a) Test fuel used
b) Fuel octane
c) Fuel pressure
d) Stabilization temperature at all instrumented points

2) Connect the detonation sensors to their recording equipment and verify their operability.
3) Attach a loading device (dynamometer) to the test vehicle and select a gear ratio, appropriate to the characteristics of the loading device, which will hold the vehicle road speed to a minimum.
4) Operate the vehicle at full throttle under load until the temperature stabilizes, and record the following:

a) Engine rpm
b) Stabilized temperatures at all instrumented points
c) Fuel pressure
d) Severity of knock at each cylinder, if possible

NOTE: Suspend the full load, full throttle test under the following conditions.

(1) The detonation rating is severe.
(2) Engine temperatures become excessive. Air-cooled engine temperatures are considered excessive when the spark plug gasket temperature reaches 525°F or as stipulated by the engine manufacturer. Liquid-cooled engine temperatures shall be considered excessive as directed in the test plan or specified by the engine manufacturer.

5) Repeat step 4 using engine speeds in decreasing increments of 200 rpm/sec down to minimum practical speed.
6) At the completion of step 5, perform the following:

a) Switch to the highest octane rated primary reference fuel.
b) Scavenge the fuel system by running the engine out of fuel twice or as indicated in the NOTE of paragraph 6.2.1.1.2, 9.

c) Record the following:

(1) Test fuel used
(2) Fuel octane

7) Repeat steps 4 and 5.
8) At the completion of step 7, repeat steps 6 and 7 using the highest rated severity reference fuel.
9) Repeat step 7 using the specification fuel of step b having the second highest octane rating.
10) Repeat step 9 using the specification fuel of step 8 having the second highest octane rating.
11) Repeat steps 9 and 10 using decreasing octane rated gasoline until severe knock or excessive temperatures develop.

6.2.1.2 Fuel Vapor Handling Capability

Determine the test vehicles fuel vapor handling capability under various operating conditions as follows:

a. Full Load Test:

NOTE: This full-throttle, full-load test is most suitable for medium and heavy tactical vehicles and all combat vehicles.

1) Attach a field dynamometer to the test vehicle.
2) Drain the fuel tank and fill it to 80% capacity with the test fuel.

NOTE: For gasoline-powered test items, use a test fuel blended to simulate, at the forecast ambient temperature, the volatility at design temperature of the most volatile specification fuel. For other than gasoline-fueled vehicles, use specification fuel of the highest volatility; i.e., lowest temperature for V/L = 20.

3) Collect a tank sample of this fuel just prior to beginning testing and label the sample "SAMPLE 1". Refrigerate the sample for subsequent analysis.
4) Perform a warm-up cycle as follows:

a) Select a gear range that will provide maximum heat rejection and a road speed of less than 15 mph under maximum rated load applied by the dynamometer. Record the gear range and speed obtained.
b) Operate the test vehicle on a level paved course at full throttle under full load until all temperatures

are stabilized or the vehicle has been operated for a maximum of 30 minutes. Record the temperature and pressure of all instrumented points.

c) Drive the test vehicle into a "soak" shelter.
d) Idle the test vehicle for two minutes and shut down the motor.
e) Collect a fuel sample, "Sample 2", from the fuel tank when the gasoline reaches maximum temperature or the vehicle motor has been shut down for 15 minutes, whichever is longer. Record the temperatures of all instrumented points and shut-down time.

5) Perform a drawbar cycle as follows:

a) Restart the engine and record the following:

(1) Time required to restart the engine
(2) Number of attempts required to start the engine

b) Accelerate the vehicle, in the gear range of step 4a, with no drawbar load, to the speed of step 4a.
c) Apply the drawbar load and record the drawbar pull.
d) Operate the test vehicle under load until the temperatures stabilize, or a maximum of 20 minutes, whichever is shorter.
e) Stop the test vehicle in the "soak" shelter and idle the engine until the fuel system temperatures reach maximum or for 10 minutes, whichever is shorter. Record the idling time and temperature and pressure of the instrumented points.
f) Collect a fuel sample from the fuel tank and label it "SAMPLE 3".

6) Repeat steps 4 and 5 alternately, taking consecutively numbered fuel samples, until the severest cycle is determined. Rate severity of cycles by degree and frequency of symptoms of premature vaporization of fuel.

Symptoms, to be rated, in order of decreasing importance, are:

a) Stalling or complete inability to start.
b) Overheating.
c) Reduced drawbar pull of 25% or more.
d) Misfiring.
e) Difficult starting requiring more than half the maximum containers cranking time.
f) Bucking or surging.
g) Rough idling.
h) Black exhaust smoke.

7) Repeat the severest cycle until one of the following has been achieved:

a) Complete vapor lock is encountered
b) A minimum of 4 cycles have been completed
c) Test fuel is consumed

b. Cross-Country Test:

NOTE: 1. This near-full-throttle test is intended for high-mobility vehicles; not intended for continuous, full-load service. It shall be performed in desert terrain appropriate to the intended mission of the vehicle, such as level sand, dry washes, or a desert cross-country course.
2. Test the vehicle with a towed load when appropriate.

1) Drain the fuel tank and fill it to 80% capacity with test fuel as described in the NOTE of paragraph 6.2.1.2.a,2.
2) Collect a sample of the test fuel immediately before beginning testing, label it "SAMPLE 1", and refrigerate it for subsequent analysis.
3) Perform a warm up cycle as follows:

a) Select a gear range, which will provide maximum speed over the chosen terrain. Record the gear range and type of terrain.
b) Operate the vehicle at normal speed for 40 minutes, then stop in the "soak" shelter. Record the vehicle speed.
c) Idle the vehicle for two minutes.
d) Shut down the vehicle until the fuel system temperatures reach a maximum, or for 15 minutes, whichever is longer. Record the temperature and pressure of the instrumented points and shut down time.

4) Perform a full-throttle cycle as follows:

a) Restart the engine and record the following:

(1) Time required to restart the engine
(2) Number of attempts required to start the engine

b) Accelerate the test vehicle at full-throttle to maximum safe speed, and operate it at maximum safe speed for 40 minutes. Record the maximum safe speed.
c) Stop the test vehicle in the "soak" shelter and idle the engine until the fuel system temperatures reach maximum or for 10 minutes, whichever is shorter. Record the temperature and pressure of the instrumented points, and the idle time.

d) Collect a fuel sample from the fuel tank and label it "SAMPLE 2".

5) Repeat steps 3 and 4 alternately, taking consecutively numbered fuel samples, until the severest cycle, as rated in paragraph 6.2.1.2, a.b, is determined.
6) Repeat the severest cycle until a complete vapor lock has been achieved, or a minimum of four cycles have been completed.

NOTE: Fuel shall be added only to obtain the requirements of step 6.

c. Highway Tests:

NOTE: This test is intended for vehicles designed for highway use or for tactical trucks. It is performed on steep desert highways such as the Daylight Pass or Oatman-Topcock courses established for tests based at the USATECOM permanent desert test facility, Yuma Proving Ground.

1) Operate the test item for a minimum of 1 hour, with its rated towed load, if appropriate. Record the length of operation and presence of load.
2) Drain the fuel tank and fill it to normal fuel level as described in the NOTE of paragraph 6.2.1.2.a.

NOTE: Deliver the test fuel in sealed 55-gallon drums and shelter them to keep its temperature below ambient air temperatures.

3) Collect a sample of the test fuel immediately before beginning testing, label it "SAMPLE 1", and refrigerate it for subsequent analysis.
4) Perform a warm-up cycle as follows:

a) Operate the test vehicle for a minimum of 10 miles in gear ranges that provide the best speed on grades and best acceleration. Record the gear range used for each percent of grade.
b) Stop the vehicle in a "soak" shelter at the foot of the severest 5 miles of uphill grade and idle the engine for two minutes.
c) Shut down the vehicle until the fuel system temperatures are a maximum or for 15 minutes, whichever is first. Record the temperature and pressure of the instrumented points and the shut down time.
d) Collect a fuel sample from the fuel tank and label it "SAMPLE 2".

5) Repeat steps 4 and 5 alternately, taking consecutively numbered fuel samples, until the severest cycle, as rated in paragraph 6.2.1.2 a,b is determined.
6) Repeat the severest cycle until the fuel supply is consumed.

NOTE: Add fuel to the fuel tank only when the tank is nearly empty.

d. Acceleration Test:

NOTE: 1. This road-load test is modeled on the automotive industry standard test of fuel vapor handling capability established by the Coordinating Research Council, Inc., (CRC). This procedure is recommended for measuring the maximum gasoline volatility tolerated by a vehicle and is particularly suitable for use with tactical and commercial type vehicles.
2. The test is performed on a dynamometer course or other level paved desert course provided with a "soak" shelter.

1) Drain the fuel tank and fill it to 20% capacity with a specification fuel having a volatility of 6 through 14 Rvp.
2) Determine a baseline for measuring acceleration, under ambient conditions as follows:

a) Using the fuel blend of step 1:

(1) Determine the vehicle's acceleration to obtain the average speed the test vehicle is capable of reaching in five seconds.
(2) Record the following:

(a) Acceleration rate
(b) Vehicle speed
(c) Vehicle inspection

(3) Repeat steps 1 and 2 for the following speeds:

(a) 25% of rated vehicle speed
(b) 50% of rated vehicle speed.
(c) 75% of rated vehicle speed
(d) 100% of rated vehicle speed

b) Repeat step a with the vehicle going in the opposite direction.

3) Warm up the test vehicle by operating it for 20 minutes at its maximum sustained road speed, using the fuel blend of step 1. At the completion of the 20 minutes, stop the vehicle in the "soak" shelter.
4) Perform an idle-soak cycle as follows:

   a) Idle the engine for 10 minutes in the "soak" shelter
   b) Accelerate the vehicle at part throttle to the 5 second average speed of step 2a.1. Record the time required to reach speed.
   c) Accelerate the vehicle at full throttle to 100% of its rated speed and record the time required to reach its rated speed.

5) Perform a hot-soak cycle as follows:

   a) Stop the vehicle in the "soak shelter"
   b) Idle the engine for 1 minute, and then shut it off
   c) Leave the engine off for 10 minutes
   d) Restart the engine, and record the following:

      (1) Time required to start the engine
      (2) Number of attempts required to start the engine

   e) Accelerate the vehicle at part throttle to the 5 second average speed of step 2.a.1. Record the time required to reach speed.
   f) Accelerate the vehicle at full throttle to 100% of its rated speed and record the time required to reach its rated speed.

6) Repeat steps 4 and 5 alternately until the severest cycle can be determined as judged by the criteria listed in paragraph 6.2.1.2 a,b.
7) Repeat the severest cycle, until complete vapor lock occurs or until acceleration times increase by 50%.
8) Repeat steps 4 through 7 with test fuels having Rvp's of 7 through 14 psi in steps of 1 psi.

6.2.1.3 Compatibility with Specification Grades of Fuels and Lubricants

The compatibility of the specified fuels, lubricants, hydraulic fluids, or related materials, under desert environments, shall be determined as described in the applicable sections of MTP 2-2-701.

6.2.1.4 Fuel Consumption

Vehicle fuel consumption under desert conditions shall be determined as described in MTP 2-2-603 and include the following on a daily basis:

a. Type of fuel used
b. Engine operating hours
c. Mileage traversed
d. Ambient temperatures

6.2.1.5 Engine Cooling System Adequacy

The engine cooling ability of the test vehicle, operating under full load, road load, and the effects of controlled differential steering on the engine cooling system shall be determined as described in the applicable sections of MTP 2-2-607.

6.2.1.6 Braking Adequacy

The braking ability shall be determined as described in MTP 2-2-608.

6.2.1.7 Drawbar Pull Test

The test vehicle tractive effort shall be determined as described in MTP 2-2-604.

6.2.1.8 Air Cleaner Adequacy

Determine the adequacy of the test vehicles air cleaner under various operating conditions as follows:

a. Operate the pilot vehicle and test vehicles(s) over the dust course maintaining a normal convoy between the lead (pilot) vehicle and test vehicle(s).

NOTE: Speed and operating mode of the convoy shall be selected as appropriate to the intended mission of the test vehicle.

b. Record the initial restriction across the air cleaner.

c. Operate the vehicle(s) on the dust course until one of the following occurs:

1) Air cleaner restriction increases to the figure at which servicing is recommended by the manufacturer's instructions or technical manuals.

d. Record the following:

1) Engine revolutions
2) Average vehicle speed
3) Relative humidity
4) Ambient wind speed
5) Final restrictions across the air cleaner
6) Reason for test termination
7) Mileage traveled
8) Operating time

e. Service the air cleaner as directed by the technical manuals or manufacturer's instructions and obtain a sample of the dust for laboratory analysis.

f. Record the time required for servicing.

g. Repeat steps a through f with the test vehicle(s) operating on either the cross-country or gravel course, whichever is more appropriate to the intended use of the vehicle.

h. Repeat steps a through g without a pilot vehicle or convoy.

i. Using the mileage values obtained for the dust and cross-country/gravel courses with and without a convoy, lay out a test course that will allow the vehicle(s), with and without a convoy, to travel 2/3 of the time on the dust course and 1/3 of the time on the gravel or cross-country course, whichever is appropriate. Record the mileages:

j. Record the test vehicle(s) restriction across the filter.

k. Operate the vehicles with a pilot vehicle, in convoy, until the conditions of step c are met, and perform the following:

NOTE: Operations shall be suspended when wind speed exceeds 15 mph.

1) Collect samples of dust from the air stream just ahead of the test vehicle(s) air intake over each of the courses for analysis of dust concentration, and record the following:

a) Direction of vehicle travel
b) Wind speed and direction

2) Record the following:

a) Total mileage traveled:

(1) Dust course
(2) Gravel/cross-country course

b) Engine revolutions
c) Average vehicle speed
d) Relative humidity
e) Ambient wind speed
f) Final restrictions across the air cleaner
g) Reason for cycle termination
h) Operating time

3) Service the air cleaner as directed by the technical manuals or manufacturer's instructions and obtain a sample of the dust for laboratory analysis.

l. Repeat step k without a convoy.

m. Repeat steps k and l, alternately, until a minimum of four complete cycles (four in convoy, four without convoy) have been completed, making adjustments in mileage, as required, to all for 2/3 of the mileage traveled to be on the dust course, and 1/3 to be on the gravel or cross-country course, as appropriate.

n. At the completion of testing, perform the following:

1) Clean the air filter element and inspect it for the following:

a) Signs of wear, deterioration, or damage.
b) Signs of abrasion caused by high-velocity and particles.
c) Embrittlement or separation of materials due to heat and desiccation.
d) Ruptures or separations caused by repeated removal, cleaning, and replacement of the filter element.

6.2.1.9 Tire and Track Testing

Tires and tracks designed for specific vehicles shall be tested, with that vehicle, under desert conditions, as described in MTP 2-2-704.

6.2.2 Mobility Tests

6.2.2.1 Sand Mobility

The ability of the test vehicle to operate over sand shall be determined as described in MTP 2-2-619.

6.2.2.2 Desert Cross-Country Mobility

Desert cross-country mobility tests shall be conducted as follows:

a. Operate the test vehicle over its selected course for the number of miles prescribed for its group in Table I and Table II. The required miles should be driven over each type of terrain which is passable by the test item within the following limitations:

1) Certain types of terrain will be essentially impassable by certain vehicles within a given group.
2) When the test item is unable to make reasonable progress in difficult terrain, the test over the terrain may be suspended on expiration of the number of operating hours shown in Table I or Table II at the discretion of the test project engineer.

NOTE: The objective of practical tests precludes arbitrary judgments about mobility in particular areas before reasonable efforts actually are made to negotiate such terrain.

b. Record the following:

1) Mileage covered, and operating time required for each terrain.

2) Time spent in towing, when required.
3) Operator/organization servicing and repairs and time to perform them.

NOTE: Do not include time spent waiting for assistance, equipment, or supplies in towing and/or service/repair time.

4) Fuel consumption, for each type of terrain, as described in MTP 2-2-603.
5) Reason for suspension of test prior to achieving full mileage, when applicable.

c. Wheeled Vehicle Tests:

1) Group I Vehicles - Group I vehicles, identified in Table III shall be tested in accordance with paragraphs 6.2.2.3 a and 6.2.2.3 b and Table V.
2) Group II Vehicles - Group II vehicles, identified in Table III, shall be tested in accordance with paragraphs 6.2.2.3 a and 6.2.2.3 b, Table V, and the following special procedures.

a) Dump bodies:

(1) Raise and lower dump bodies the equivalent of at least once for every ten miles, with complete dumping and reloading at the completion of testing. When practicable, this test should be made on actual jobs requiring dump truck service.
(2) Record the ability of the dump bodies to operate satisfactorily.

b) Crane and wrecker trucks:

(1) Operate crane and wrecker trucks with all accessory equipment properly stowed.
(2) Evaluate the ability of the crane and wrecker to assist in performing maintenance, supply and recovery operations by the following methods:

(a) Perform lifting operations, simulated or actual, for two hours after each eight hours of road operation.
(b) Perform one simulated or actual recovery after each 25 miles of operation.
(c) Operate the crane at full load using all accessories and with the vehicle repositioned at least four times during each period of lifting operation.

TABLE V. Mobility Tests - Example of Immobilization Data Presentation

Traverse No.	Immo No.	Photo No.	Immobilization On Course	Immobilization Left Course	Trafficability Data: Tracking	Rut Depth (in.)	Cone Index	Slope (°)	Moisture (% Dry)	Terrain Factors: Micro-geom	Macro-geom	Up or Down Slope	Relief (ft)	Ground: Soil Type	Soil Consistency	Landscape PP	SO	CS	CR	Remarks
Mountain Course																				
1	1	-	X			-	-	50	-	-	X	UP	70+	4	1	4	5	5	6	Failed to hold traction
1	2	-	X			-	-	80	-	X	-	UP	8+	4	2	2	5	6	5	Route chosen led to descent against wash bank
2	3	1-1	X			-	-	20	-	X		UP	-	2	9	2	5	6	5	Insufficent lateral clearance
3	11	-	X			-	30	30	-	X	-	UP	50+	4	2	4	5	5	6	Ridge impassable to driver
Badlands/hills																				
1	15	2-1	X			8	25	15	5%	X	-	UP	-	7	1	4	4	4	3	High centered when crossing gully

(d) The crane and winch shall be operated simultaneously once during each recovery, if practical.

c) Ambulances, tankers, and cargo vans:

(1) Ambulances shall be loaded and unloaded once during each 8-hour shift.
(2) Tankers shall be loaded and unloaded once for each 40 test miles. A container shall be available to store the unloaded fluid.
(3) Cargo van bodies shall be loaded and unloaded each 100 miles of test operation.

NOTE: Unloading and reloading vehicle bodies and tanks is a time consuming and expensive operation. Limited funds or short-time test schedules necessitate keeping these operations to a minimum.

(4) Pumps and other mounted equipment shall be operated as test conditions require. During extended periods when there shall be no normal requirement to operate these components, they shall be operated sufficiently to determine operability and the absence of leaks and unusual noises.

6.2.2.3 Durability Test

Durability testing the vehicles shall be determined as follows:

a. Operate the test vehicle over its selected course. Reasonable and practical speeds for the particular course conditions shall be maintained. Preventive maintenance shall be performed as prescribed in the applicable instruction manuals. In addition, vehicles, their accessories and kits shall be inspected at least once during each eight hours of operation for deficiencies, damage or unusual wear.

b. Record the following for each vehicle tested:

1) Vehicle mileage as measured by the odometer.
2) Engine hours (total running time).
3) Engine hours (idling time and operating time).
4) Fuel consumption as described in MTP 2-2-603.
5) Component failures.
6) Vehicle performance deficiencies.
7) Parts Mortality.
8) Required component adjustments.
9) Ambient conditions and surface conditions affecting performance of the test vehicle.
10) Maintenance time required, and man-hours of labor required at each echelon of maintenance.

NOTE: The desert cross-country mileages prescribed in Tables III and V, are identical to those shown in Table I and II for desert cross-country mobility testing. The desert road mileages are proportioned to desert cross-country mileages as intermediate-climate road mileages are to cross-country mileages of MTP 2-2-506, and MTP 2-2-507, as by the multiplying factor of Tables IV and V. The difference in mileage is intended to reflect the relative scarcity of roads in the world's desert regions, the good trafficability of regions abounding in desert flats, and the probability that vehicles used in desert military operations will tend to be driven largely over unimproved natural surfaces.

11) Groups III through V vehicles - Groups III through V vehicles identified in Table III shall be tested in accordance with paragraphs 6.2.2.3 a and 6.2.2.3 b, and Table III
12) Group VI vehicles - Group VI vehicles, identified in Table III shall be tested in accordance with paragraphs 6.2.2.3 a and 6.2.2.3 b, Table III and the following special procedures.
13) Groups VII and VIII Vehicles - Groups VII and VIII vehicles, identified in Table III shall be tested in accordance with paragraphs 6.2.2.3 a and 6.2.2.3 b.

    a) Measure the capacity of pumps at the start and conclusion of testing.
    b) Operate all mounted equipment, ladders, etc., to determine adequacy of vehicle operation.

c. Tracked Vehicle Tests

1) Groups I through V vehicles - Groups I through V vehicles shall be tested in accordance with paragraphs 6.2.2.3 a, and 6.2.2.3 b, and Table III.
2) Accessory and Vehicular kits shall be tested in accordance with Table III and the following shall be recorded.

    a) Item under test
    b) Vehicle mileage
    c) Hours of operation
    d) Component failures
    e) Lubricant used, when required
    f) Parts mortality
    g) Required component adjustments, when applicable
    h) Performance deficiency
    i) Conditions affecting accessory or kit performance

TABLE VI. Checklist for Desert Human Engineering Evaluation of Vehicle Design

Human Factor	Possible Condition
Heat Stress	Any symptoms of incipient heat stroke? Any symptoms of incipient heat exhaustion? Any occasions when heat-induced fatigue delayed or curtailed operations? Rate heat encountered in operation of the test item as compared with a similar standard vehicle: Cooler, hotter, much hotter? Comfortable, uncomfortable, severe, intolerable? What standard vehicle?
Burning Temperatures	Any encounters with painfully hot parts? What parts? Specify. Classify as frequently used controls, occasionally used controls or handholds, normally accessible parts, or infrequently touched parts. Any burns suffered: First, second, or third degree?
Ventilation	Does air in vehicle become uncomfortably dusty, bad enough to require dust mask or goggles? Do objectionable fumes get into vehicle - exhaust fumes, other fumes? Do fumes irritate eyes, respiratory tract, skin? WARNING: Fumes from petroleum-fueled engines contain carbon monoxide, a colorless, odorless gas which has cumulative toxic effects and is lethal in high concentrations. Operation shall be suspended if exhaust fumes are regularly present in noticeable quantities.
Noise	Does noise interfere with vocal communication? Any painful or uncomfortable noise levels? Any after effects from noise? Any need for ear plugs, etc?
Visibility	Any visibility problems in operation of the test item? Any difficulty reading gages, indicators, instruction plates? Any problems due to contrasting brightness levels, glare, reflections?

(Checklist continued)

Does airborne dust interfere with visibility?
Do dust accumulations affect vision?
Does hot-climate operating mode alter visibility in any respect?

6.2.2.4 Security from Detection

Determine the test vehicle's security from detection as described in MTP 2-2-615.

6.2.2.5 Maintenance

Determine the test vehicle's maintenance as described in MTP 2-2-503.

NOTE: All necessary deviations from the preestablished procedures shall be noted for inclusion in the test report.

6.2.2.6 Human Engineering

Determine the test vehicle's human engineering aspects as described in MTP 2-2-803.

6.2.2.7 Safety

Determine the vehicle safety test as described in MTP 2-2-508.

6.3 TEST DATA

6.3.1 Initial Inspection

Record the following for each vehicle tested

a. All deficiencies encountered
b. All items repaired or replaced
c. All photographs taken

6.3.1.1 Preliminary Operation

Data shall be collected and recorded as described in MTP 2-2-505.

6.3.1.2 Vehicle Mechanical Inspection Tests

Data shall be collected and recorded as described in MTP 2-2-502.

6.3.1.3 Vehicle Characteristics

Data shall be collected and recorded as described in MTP 2-2-500 and MTP 2-2-501.

6.3.2 Performance Tests

6.3.2.1 Octane Requirements

Record the following for each vehicle tested

a. Road-Load Acceleration Tests:

1) Warm up:

a) Specification fuel used
b) Fuel octane
c) Fuel pressure in psi
d) Stabilization temperature, in °F

(1) For air-cooled engines;

(a) Carburetor inlet air.
(b) Each spark plug gasket (identify each gasket).
(c) Each position in the cooling air system (indicate location).
(d) Engine oil sump.

(2) For liquid-cooled engines:

(a) Carburetor inlet air
(b) Oil sump
(c) Coolant leaving the engine

e) Knock detection sensor used.
f) Rating (A, B, etc.) and location of each detonation sensor

1) Meteorological data:

a) Wet bulb temperature, in °F
b) Dry bulb temperature, in °F
c) Absolute barometric pressure, in psi

2) Acceleration runs

a) Gasoline used (specification fuel, primary reference fuel, etc.).
b) Octane rating.
c) Gear ratio.
d) Run number.
e) Fuel pressure, in psi.
f) Stabilization temperature, in °F.

(1) Air-cooled engine:

(a) Carburetor inlet air.
(b) Each sparkplug gasket (identify each gasket)
(c) Each position in the cooling air system
(d) Engine oil sump

(2) For liquid-cooled engines:

(a) Carburetor inlet air
(b) Oil sump
(c) Coolant leaving the engine

g) Engine speed, in rpm, at which, when applicable:

(1) Knock is detected
(2) Knock disappears

h) Engine speed, in rpm, and severity of knock (A, B, C) for each each occurrence of knocking (reference 6.2.1.1, Note 2a through d).

b. Road-load Deceleration Tests:

1) For warm-up:

a) Specification fuel used (combat gasoline, MIL-G-3056)
b) Fuel octane (100)
c) Fuel pressure, in psi
d) Stabilization temperature, in °F

e) Rating (A, B, etc.) and location of each detonation sensor

2) For meteorology data:

a) Wet bulb temperature, in °F
b) Dry bulb temperature, in °F
c) Absolute barometric pressure, in psi

3) For each deceleration run:

a) Gasoline used (primary reference fuel, severity reference fuel, etc).
b) Octane rating.
c) Gear ratio (3rd, 2nd, etc.).
d) Run number (1, 2, or 3).
e) Fuel pressure, in psi.
f) Stabilization temperature, in °F.

(1) For an air-cooled engine:

(a) Carburetor inlet air.
(b) Each sparkplug gasket (identify each gasket).
(c) Each position in the cooling air system. (indicate location).
(d) Engine oil sump.

(2) For a liquid-cooled engine:

(a) Carburetor inlet air
(b) Oil sump
(c) Coolant leaving the engine

g) Engine speed, in rpm, at which, when applicable:

(1) Knock is detected
(2) Knock disappears

h) Engine speed, in rpm, and severity (A, B, C) for each occurrence of knocking.

c. For full-load, full-throttle tests:

1) For warm-up:

a) Specification fuel used
b) Fuel octane
c) Fuel pressure, in psi
d) Stabilization temperature, in °F

(1) For air-cooled engines:

(a) Carburetor inlet air.
(b) Each sparkplug gasket (identify each gasket).
(c) Each position in the cooling air system (indicate location).
(d) Engine oil sump.

(2) For liquid-cooled engines:

(a) Carburetor inlet air
(b) Oil sump
(c) Coolant leaving the engine

6.3.2.2 Fuel Vapor Handling Capacity

a. Record the following meteorological data during each test:

1) Ambient temperature, in °F
2) Relative humidity, in %
3) Absolute barometric pressure, in psi
4) Wind speed (in mph) and direction (E, W, etc.)
5) Solar radiation, in BTU/ft^{2}hr

b. Record the following for the full load test:

1) Test fuel used (combat gasoline, automotive gasoline)
2) Fuel Reid vapor pressure rating (6, 8, 10, etc)
3) Gear ratio used (2nd, 3rd, etc.)
4) Cycle number (1, 3, 5, etc.)
5) Severity rating (overheating, misfiring, etc.)
6) For each warm-up position of the total cycle:

a) Warm up

(1) Vehicle speed obtained, in mph
(2) Engine speed obtained, in rpm
(3) Stabilized temperature, in °F, at:

(a) Fuel tank (at fuel line)
(b) Fuel pump inlet
(c) Carburetor inlet
(d) Engine oil sump
(e) Coolant temperature (for liquid-cooled engines)
(f) Sparkplug temperature (for air-cooled engines)

(4) Fuel pressure, in psi, at:

(a) Fuel tank (at fuel line)
(b) Carburetor inlet

b) Post idling:

(1) Shutdown time, in minutes

(2) Maximum fuel temperature achieved (at fuel line)
(3) Temperatures, in °F, at:

(a) Fuel pump inlet
(b) Carburetor inlet
(c) Engine oil sump
(d) Coolant temperature (for liquid-cooled engines)
(e) Sparkplug temperature (for air-cooled engines)

7) For each drawbar pull portion of the total cycle:

a) Time required to start engine, in minutes
b) Number of starting attempts
c) For drawbar pull:

(1) Drawbar load, in pounds
(2) Operating time, in minutes
(3) Temperature, in °F, at:

(a) Fuel tank (at fuel line)
(b) Fuel pump inlet
(c) Carburetor inlet
(d) Engine oil sump
(e) Coolant temperature (for liquid-cooled engines)
(f) Sparkplug temperatures (for air-cooled engines)

(4) Fuel pressure, in psi, at:

(a) Fuel tank (at fuel line)
(b) Carburetor inlet

d) For idling time:

(1) Idling time, in minutes
(2) Temperature, in °F, at:

(a) Fuel tank (at fuel line)
(b) Fuel pump inlet
(c) Carburetor inlet
(d) Engine oil sump
(e) Coolant temperature (for liquid-cooled engines)
(f) Sparkplug temperature (for air-cooled engines)

8) For each fuel sample chemical analysis:

a) Sample number (1, 3, 5, etc.).
b) Temperature, in °F, at which each fuel sample shows vapor-liquid ratios of:

(1) 10
(2) 20
(3) 30

9) Reason for suspending test (complete vapor lock, out of fuel, etc.)

c. Record the following for each vehicle tested on the cross-country tests:

1) Test fuel used (combat gasoline, automotive gasoline)
2) Fuel Reid vapor pressure rating
3) Gear ratio used
4) Cycle number
5) Type of terrain
6) Severity rating (black smoke, overheating, etc.)
7) For each warm-up portion of the total cycle:

a) Warm up:

(1) Vehicle speed obtained, in mph
(2) Engine speed obtained, in rpm

b) Post idling:

(1) Shutdown time, in minutes.
(2) Temperatures, in °F, at:

(a) Fuel tank (at fuel line)
(b) Fuel pump inlet
(c) Carburetor inlet
(d) Engine oil sump
(e) Coolant temperature (for liquid-cooled engines)
(f) Sparkplug temperature (for air-cooled engines)

(3) Fuel pressure, in psi, at:

(a) Fuel tank (at fuel line)
(b) Carburetor inlet

8) For full-throttle portion of the total cycle:

a) Time required to restart engine, in minutes
b) Number of attempts required to start engine
c) Maximum vehicle speed obtained, in mph
d) Idling:

(1) Idling time, in minutes
(2) Temperatures, in °F, at:

(a) Fuel tank (at fuel line)
(b) Fuel Pump inlet
(c) Carburetor inlet

(d) Engine oil sump
(e) Coolant temperature (for liquid-cooled engines)
(f) Sparkplug temperature (for air-cooled engines)

(3) Fuel pressure, in psi, at:

(a) Fuel tank (at fuel line)
(b) Carburetor inlet

9) For each fuel sample chemical analysis:

a) Sample number
b) Temperature, in °F, at which each fuel sample shows vapor-liquid ratios of:

(1) 10
(2) 20
(3) 30

10) Reason for terminating the test (complete vapor lock, complete 4 cycles).

d. Record the following for each vehicle tested on the highway course:

1) Test fuel used (combat gasoline, automotive gasoline)
2) Fuel Reid vapor pressure rating
3) Cycle number
4) Severity rating (rough idling, bucking or surging, etc)
5) For each warm-up portion of the total cycle:

a) Gear range (2nd, 3rd, etc.) for each percent of grade
b) Shutdown time, in minutes
c) Temperatures, in °F, at:

(1) Fuel tank (at fuel line)
(2) Fuel pump inlet
(3) Carburetor inlet
(4) Engine oil sump
(5) Coolant temperature (for liquid-cooled engines)
(6) Sparkplug temperature (for air-cooled engines)

d) Fuel pressures, in psi, at:

(1) Fuel tank (at fuel line)
(2) Carburetor inlet

6) For each uphill portion of the total cycle:

a) Time required to restart the engine, in minutes.
b) Number of attempts required to restart the engine (1, 3, 5, etc.).
c) Maximum speed obtained, in mph.
d) Idling time, in minutes.
e) Temperatures, in °F, at:

(1) Fuel tank (at fuel line)
(2) Fuel pump inlet
(3) Carburetor inlet
(4) Engine oil sump
(5) Coolant temperature (for liquid-cooled engines)
(6) Sparkplug temperature (for air-cooled engines)

f) Fuel pressure, in psi, at:

(1) Fuel tank (at fuel line)
(2) Carburetor inlet

7) For each fuel sample chemical analysis:

a) Sample number (1, 3, 5, etc.)
b) Temperature, in °F, at which each fuel sample shows vapor-liquid ratios of:

(1) 10
(2) 20
(3) 30

e. Record the following for each vehicle subject to the acceleration test:

1) For baseline measurements:

a) Specification fuel used (combat gasoline, automotive gasoline).
b) Octane rating (95, 100, etc.).
c) Speed requirements (average, 25%, rate, 75% rated, etc.).
d) Acceleration rate, in miles/sec^2.
e) Vehicle direction.

2) For each total cycle:

a) Fuel Rvp rating
b) Cycle number
c) Severity rating (rough, idling, black smoke, etc.)
d) For the idle-soak portion of the total cycle:

(1) Obtained speed (5 sec average, 100% rated)
(2) Time required to obtain the speed, in seconds

e) For the hot-soak portion of the total cycle:

(1) Time required to restart engine, in minutes
(2) Number of attempts required to restart engine

3) Reason for terminating test (complete vapor lock, acceleration deterioration).

6.3.2.3 Compatibility with Specification Grades of Fuels and Lubricants

Data shall be collected and recorded as described in the applicable sections of MTP 2-2-701.

6.3.2.4 Fuel Consumption

Record the following for each vehicle tested:

a. Data collected as described in MTP 2-2-603
b. Fuel used
c. Engine operating hours
d. Mileage traversed
e. Ambient temperature, in °F

6.3.2.5 Engine Cooling System Adequacy

Data shall be collected and recorded as described in the applicable sections of MTP 2-2-607.

6.3.2.6 Braking Adequacy

Record the following for each vehicle tested:

a. Data collected as described in the applicable sections of MTP 2-2-608.
b. Evidence of deficiencies.

6.3.2.7 Drawbar Pull Test

Data shall be collected and recorded as described in the applicable sections of MTP 2-2-607. In addition, when possible, compare the data obtained under desert conditions with that obtained in intermediate (moderate) climates.

NOTE: Difference between desert and moderate environmental conditions run approximately 10% for vehicles powered by gasoline engines, somewhat greater for turbine engines, and somewhat less for diesel engines.

6.3.2.8 Air Cleaner Adequacy

Record the following for each vehicle tested:

a. For pre-cycle testing:

1) Test course (dust, gravel, etc.).
2) Method of test (convoy, alone).
3) Initial air cleaner restriction, in psi.
4) Engine revolutions.
5) Average vehicle speed, in mph.
6) Relative humidity, in percent.
7) Ambient wind speed, in mph.
8) Final restrictions across the air cleaner, in psi.
9) Reason for test termination (service requirements, impaired performance).
10) Mileage traveled.
11) Operating time.

b. For Cycle testing:

1) Method of test (convoy, alone)
2) Cycle number (1, 3, 5, etc.)
3) Course mileage:

a) Dust.
b) Gravel/cross-country

4) Initial air cleaner restriction, in psi
5) For each dust sample:

a) Sample number.
b) Direction of vehicle (east, north, etc.).
c) Wind velocity, in mph.
d) Wind direction, (from east, south, etc.).
e) Dust density, in milligrams of dust per cubic feet of air.

6) Total mileage traveled:

a) Dust course
b) Gravel/cross-country course

7) Engine revolutions
8) Average vehicle speed, in mph
9) Relative humidity, in percent
10) Ambient wind speed, in mph
11) Final restrictions across the air cleaner, in psi

12) Reason for cycle termination (service, impaired operation)
13) Operating time

c. For Post-Test:

1) Signs of wear, deterioration, or damage.
2) Signs of sand caused abrasion.
3) Embrittlement or separation due to heat.
4) Ruptures or separation caused by removing cleaning and replacing.
5) Indication of leaks.
6) Maximum particle size.

6.3.2.9 Tire and Track Testing

Record the following, as applicable:

a. Tire data collected and recorded as described in the applicable sections of MTP 2-2-704.
b. Track data collected and recorded as described in the applicable sections of MTP 2-2-507.

6.3.2.10 Mobility Tests

6.3.2.11 Sand Mobility

Data shall be collected and recorded as described in the applicable sections of MTP 2-2-619.

6.3.2.12 Desert Cross-Country

Record the following for each vehicle tested:

a. Course traversed
b. For each type of terrain:

1) Mileage traversed.
2) Time required, in hours.
3) Time spent towing, in minutes, when required.
4) Repairs required.
5) Time required to perform repairs, in hours.
6) Fuel consumption, for each type of terrain, collected as described in MTP 2-2-603.
7) Reason for suspending test prior to achieving full mileage.

6.3.2.13 Durability

a. For wheeled vehicled

1) Record the following for each vehicle tested:

a) Vehicle mileage.
b) Engine hours (total running time).
c) Engine hours (idling time).
d) Fuel consumption collected as described in MTP 2-2-603.
e) Component failures.
f) Vehicle performance deficiencies.
g) Parts mortality.
h) Required component adjustments.
i) Ambient conditions and surface conditions affecting the vehicles performance.
j) Maintenance time collected as described in paragraph 6.3.4.
k) Man-hours, for each echelon of maintenance, collected as described in paragraph 6.3.4.

2) Record the following for Group II vehicles only:

a) Dump body ability to:

(1) Raise
(2) Lower
(3) Function under load

b) Crane and wrecker ability to operate

(1) After eight hours of road operation
(2) After 25 miles of road operation
(3) Simultaneously with the winch

c) Ambulance, tanker, and cargo van:

(1) Adequacy of loading and access facilities:

(a) Ambulance once every eight-hour shift
(b) Tankers once each 40 test miles
(c) Cargo van once each 100 test miles

d) Reliability and serviceability of:

(1) Pumps
(2) Other mounted equipment

3) Record the following for Group IV vehicles only:

a) Pump capacity, in gallons per hour:

(1) Start of testing
(2) Conclusion of testing

b) Operability of other equipment

b. Tracked vehicles:

1) Record the following for Groups I through V:

a) Vehicle mileage.
b) Engine hours (total running time).
c) Engine hours (idling time).
d) Fuel consumption collected as described in MTP 2-2-603.
e) Engine oil used, in quarts.
f) Gear lubricant used, in pints.
g) Coolant used, in pints, if applicable.
h) Component failures.
i) Vehicle performance deficiencies.
j) Parts mortality.
k) Required component adjustments.
l) Ambient conditions and surface conditions affecting the vehicles performance.

6.3.3 Exposure and Storage Tests

Record the following:

a. For periodic inspection:

1) Data collected as described in the Periodic Inspection section of MTP 2-2-502.
2) Average temperature, in °F.
3) Average wind speed, in mph.
4) Average wind direction.
5) Average humidity, in percent.
6) Average solar radiation, in Btu/ft^2hr.
7) Average ozone concentration.

b. Data collected as described in the Final Inspection section of MTP 2-2-502.

c. All evidence of material deterioration as determined by visual inspection.

d. All parts replaced or repaired.

6.3.4 Maintenance

Data shall be collected and recorded as described in the applicable sections of MTP 2-2-503.

6.3.5 Security from Detection

Data shall be collected and recorded as described in the applicable sections of MTP 2-2-615.

6.3.6 Human Engineering

a. Data shall be collected and recorded as described in MTP 2-2-803
b. Retain the questionnaires filled out:

1) After 1/3 of testing had been accomplished
2) At the completion of testing

6.3.7 Safety

Data shall be collected and recorded as described in the applicable procedures of MTP 2-2-508

6.4 DATA REDUCTION AND PRESENTATION

6.4.1 Performance Tests

6.4.1.1 Octane Requirements

Engine octane requirement data is best presented by graphs on which the points at which B knock becomes C knock (the B-C points) are plotted against engine speed and the octane ratings of the test fuel blends. These points will form curves whose peaks represent the minimum engine octane requirements under the given set of conditions. Aural observations are not rated for severity. Instead, engine speeds at which knock appears (and, if possible, disappears) are plotted against test blend octane ratings.

A complete graph of each of the test phases described above will show one curve for each of the series of reference fuels. A short straight line will show performance on specification fuel. A third curve should be plotted to show the motor-method octane ratings of the severity reference fuel blends.

If a comparable report of previous intermediate-climate engine octane requirements tests of the vehicle is available, it may be helpful to plot those results on the same graphs for ready comparison; the displacement of the curves may be presumed to represent effects of the desert environment insofar as other factors are constant.

The test report shall summarize all recorded data and should describe any unusual operating characteristics encountered. Analysis of the data shall include (a) relationship of the engine octane requirement to the allowable range of octane numbers of the specification fuel, (b) secondary effects of minimal fuel octane number (e.g., overheating, loss of performance, erratic engine operation), and (c) suggestions for improvements (e.g., altering spark advance curve, altering fuel-air ratio, design changes to decrease temperature of carburetor intake air).

6.4.1.2 Fuel Vapor Handling Capacity

The following presentation shall be made:

a. Methods used for blending, handling, sampling, and analyzing the test fuels shall be fully described.

b. Curves depicting the temperature at which the various fuel samples obtain V/L values of 10, 20, and 30 shall be prepared.

c. A graphical representation of the Rvp and distillation curves of the samples shall be prepared.

d. Performance of the test item plotted against the test fuel volatility or fuel system temperatures and pressures.

e. Observations concerning critical operating conditions and critical points of the fuel system at which premature vaporization occurs, and recommendations for improving the fuel vapor handling capabilities of the test item.

6.4.1.3 Compatibility with Specification Grades of Fuels and Lubricants

Data shall be evaluated and presented as described in MTP 2-2-701.

6.4.1.4 Fuel Consumption

Data shall be evaluated and presented as described in MTP 2-2-603.

6.4.1.5 Engine Cooling System Adequacy

Data shall be evaluated and presented as described in MTP 2-2-607.

6.4.1.6 Braking Adequacy

Data shall be evaluated and presented as described in MTP 2-2-608.

6.4.1.7 Drawbar Pull Test

Data shall be evaluated and presented as described in MTP 2-2-604.

6.4.1.8 Air Cleaner Adequacy

The test report shall contain the following:

a. Estimated operating hours between servicings in an atmosphere of zero visibility (25 mg of dust per cubic foot of air) based on the total data collected.

b. Estimated operating hours between servicings in the standard dust concentration for:

1) Cycles run with a leading vehicle
2) Cycles run without a leading vehicle

This difference shall be presented as a measure of the extent to which the test vehicle is affected by another vehicles dust rather than its own.

c. Decreased filtration capability with repeated servicings which will be indicated by:

1) A decreased air volume or
2) Decreased dust entrampment

For successive cycles:

d. Maximum size of dust particles passed by the air cleaner.
e. Condition of the entire air cleaner installation at the completion of the test.

6.4.2 Mobility Tests

6.4.2.1 Sand Mobility

Data shall be evaluated and presented as described in MTP 2-2-619.

6.4.2.2 Desert Cross-Country Mobility

Compute the average speed of the test vehicle over the different types of terrain. This average speed is a quantitative measurement of desert cross-country mobility of the vehicle and shall be used to compare the cross-country mobility of different vehicles.

6.4.2.3 Durability Test

6.4.2.3.1 Wheeled and Tracked Vehicles

a. All data shall be summarized to reveal significant deficiencies and overall fuel and lubricant consumption.
b. Charts and graphs shall be prepared to show operations versus maintenance time, component failures, parts mortality, etc.

6.4.2.3 Accessories and Kits

a. Data shall be summarized to reveal significant deficiencies.
b. Charts and graphs shall be prepared to show operation versus maintenance time, component failures, parts mortality, etc.

6.4.3 Exposure and Storage Tests

Deteriorated materials shall be analyzed to yield numerical measurements of qualities from which extrapolations can be made to predict the progress of deterioration and the probable service life of the part. When compared with the design life of the test vehicle, desert mortality rates and maintenance factors for the affected part should be estimated realistically and presented in graphical form as indicated in Figure 3. If these estimates differ significantly from experience with the test item in other climates, recommendations should be made for design changes to improve resistance of the test item to desert environmental factors.

6.4.4 Maintenance

6.4.5 Security and Detection

Data shall be evaluated and presented as described in MTP 2-2-503.

6.4.6 Human Engineering

a. Data shall be evaluated and presented as described in MTP 2-2-803.
b. The results of the questionnaire shall be summarized and, as required, recommendations shall be presented for design changes to eliminate those factors which hinder normal operation and curtail the test personnel operating ability.

6.4.7 Safety

Data shall be evaluated and presented as described in MTP 2-2-508.

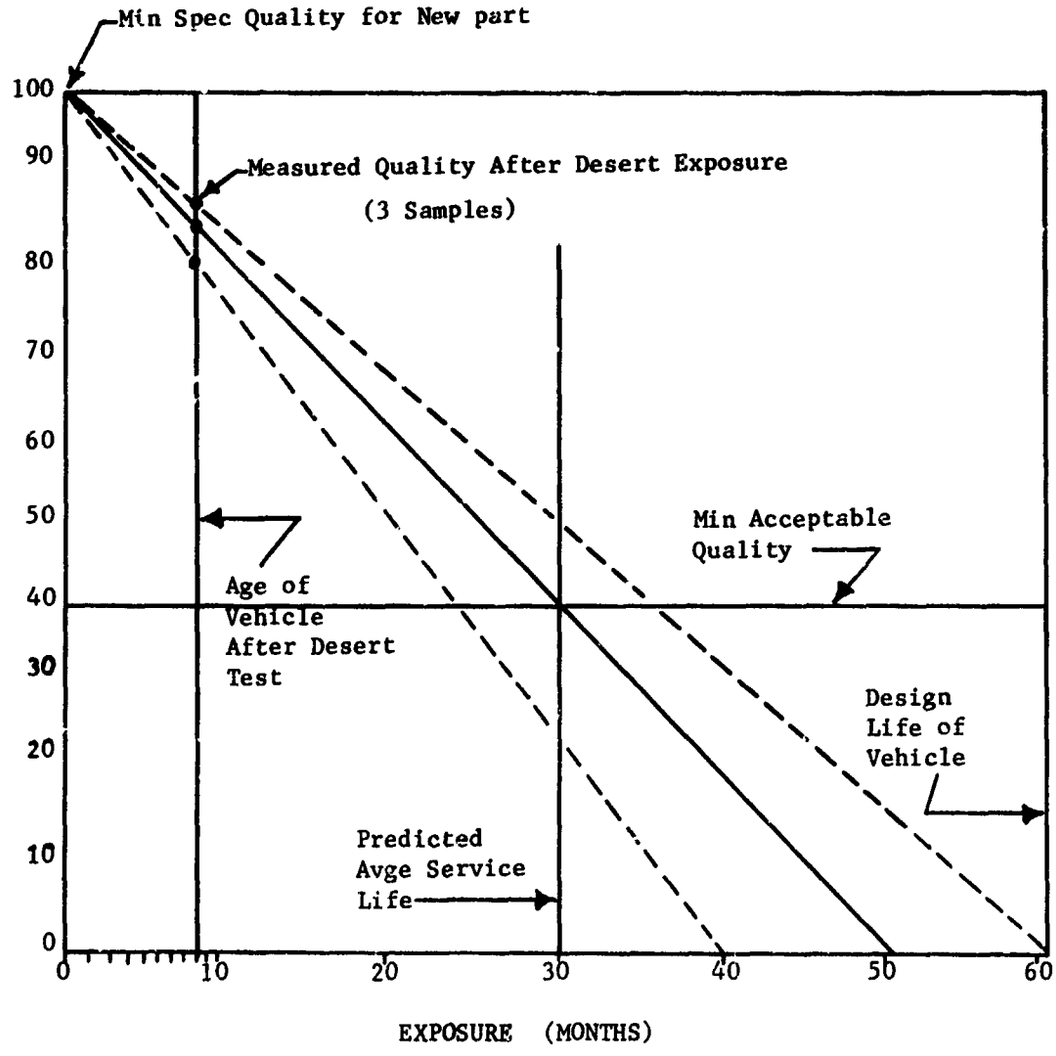

Figure 3. Plotted Prediction of Service Life--Example

APPENDIX A

DESERT TERRAIN FACTORS IN MOBILITY TESTING

1. BACKGROUND

1.1 THE WORLD's DESERTS

Definitions of the word "desert" vary considerably. For the purpose of desert operation, however, the following definition includes the main elements of the many definitions in existence:

> "A desert is a region with an arid climate, in which the potential evaporation rate exceeds the precipitation rate. The arid climate results over a long period of time in the scanty vegetation which is characteristic of such a climate. The lack of vegetation cover, in turn, results in soils with a low organic content, contributes directly to the distinctive shaping of the topography."

Deserts can be classified in many different ways. Most of the classification systems are based on either climatic, terrain, or vegetation factors. Due to the variation of classification systems, and difference of definitions, it is difficult to map the boundaries of the world's deserts. Ramaley studied this problem, and plotted the boundaries indicated by the various authorities agreed were desert, and a "Transition" area, where only one or more authorities indicated deserts exist.

Army testing in the desert is based on the "extreme hot-dry" climate specified in AR 705-15. The relationship between the areas thus defined, and Ramaley's desert areas (including the "transition" area) is shown in Figure A-1 and A-1.a.

Regardless of the definition of a desert, all authorities agree that deserts account for more than 15 percent of the world's land surface. As this percentage contains some of the world's most strategic areas, it is vital that Army materiel can operate effectively in deserts. Terrain factors are a major determinant to vehicle operation in any area, and particularly so in deserts.

2. TERRAIN CLASSIFICATION SYSTEMS

There are three basic terrain classification systems. The first of these systems is based on physical geography. Used primarily for large areas it utilizes general description such as "mountains" or "desert plains". Most of the terrain information in the world is expressed in terms of this classification.

The second system is based on geomorphology. More definitive than the physical geographic system, this system includes in the description the causative agent or the relation of the subject to its surroundings. Examples of this system are "alluvial fans" and "fault block mountains".

The third system is based on physiographic associations. A multitude of factors, such as weathering agents, vegetation, soil types, and climatic are considered in mutual relationship. Examples of input to this system are the studies of the Corps of Engineers' Waterways Experiment Station, cited below. This system is the most preferable for quantitative description of test parameters, but is extremely demanding in data, analysis, presentation, and application. It does have the advantage of permitting meaningful integration of similarly developed classification systems for other environmental factors.

The material in this appendix will be developed in terms of the second, or geomorphic, system. Much of the data, however, will be derived from physiographic association studies. Where possible, the two systems will be correlated.

2. DESERT TYPES

All deserts possess to one degree or another certain basic terrain types. The predominance of any one type will change as the area progresses to a more mature stage (see Figure A-2). Consequently, if these stages were evaluated on a gross approach, certain factors would not be considered.

3. DESERT COMPONENTS

An exhaustive listing of desert components would cover many pages. Fortunately, these components can be gathered under certain broad headings. These summaries include mountains, badlands and hills, fans and washes, desert flats and plains, and sand dunes and fields. (Each heading is discussed in more detail below. For the reader who is interested in quantitative descriptions, and possible further breakdown, the physiographic association classification used by the Corps of Engineers' Waterways Experiment Station, Vicksburg, Mississippi (WES) is included).

The WES landscape classification is based on a four digit code. These four digits may describe either a component (micro-) or a gross (macro-) landscape (Figure A-3). The first digit describes the characteristic plan-profile (Figure A-4). The second, third, and fourth digits describe slope occurrence, characteristic slope and characteristic relief, respectively (Table A-1).

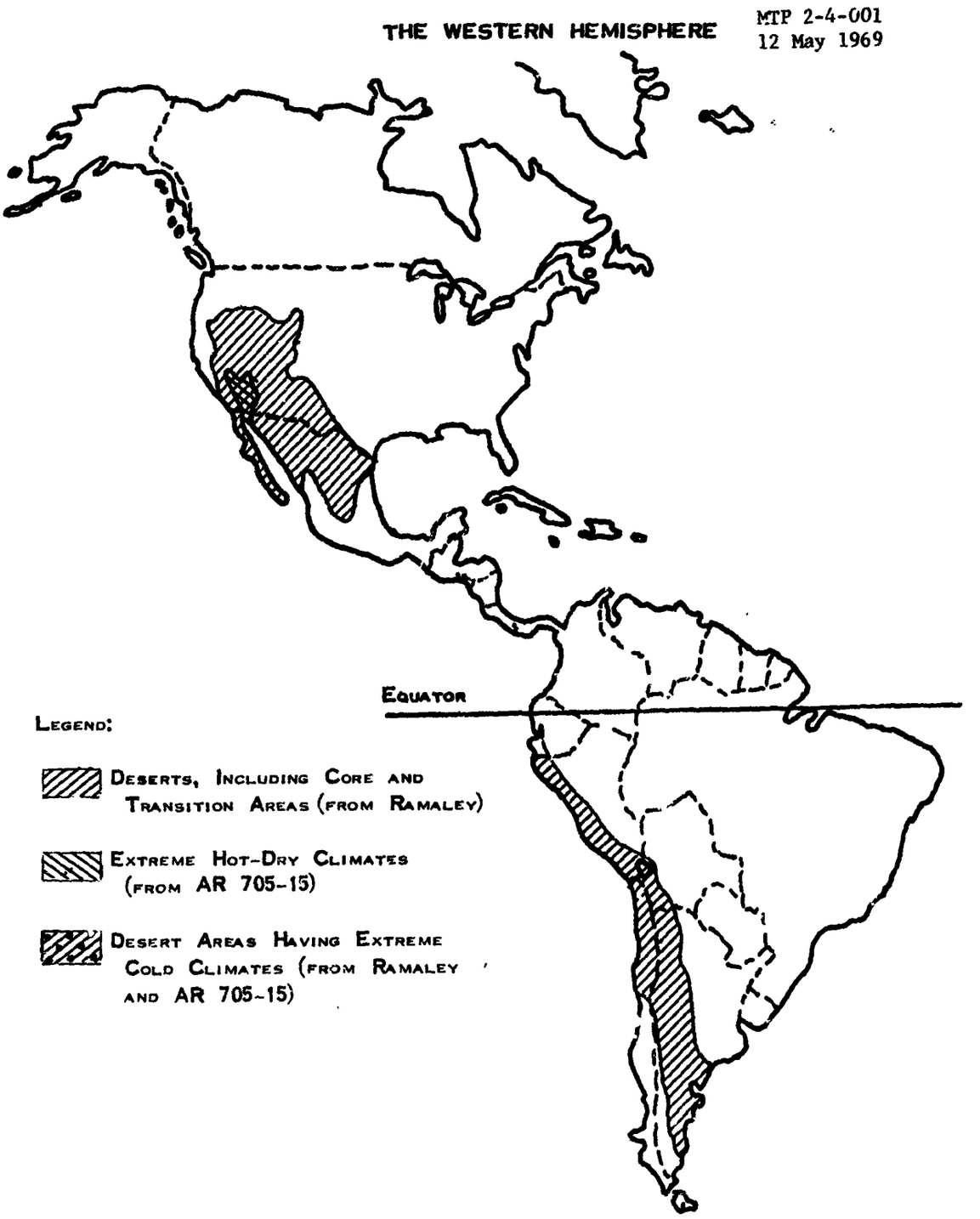

Figure A-1 Desert Areas

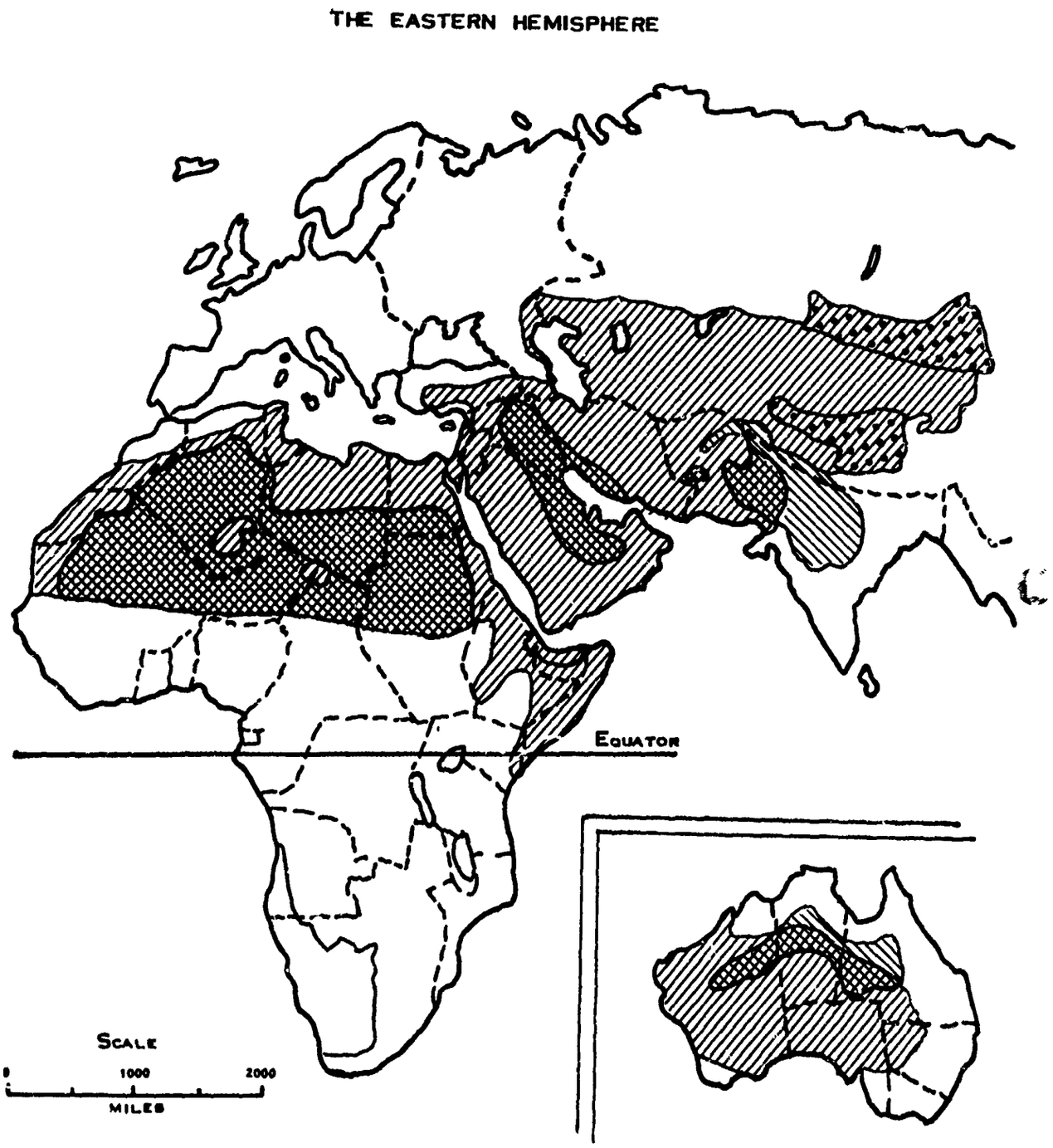

Figure A-1.a Desert Areas

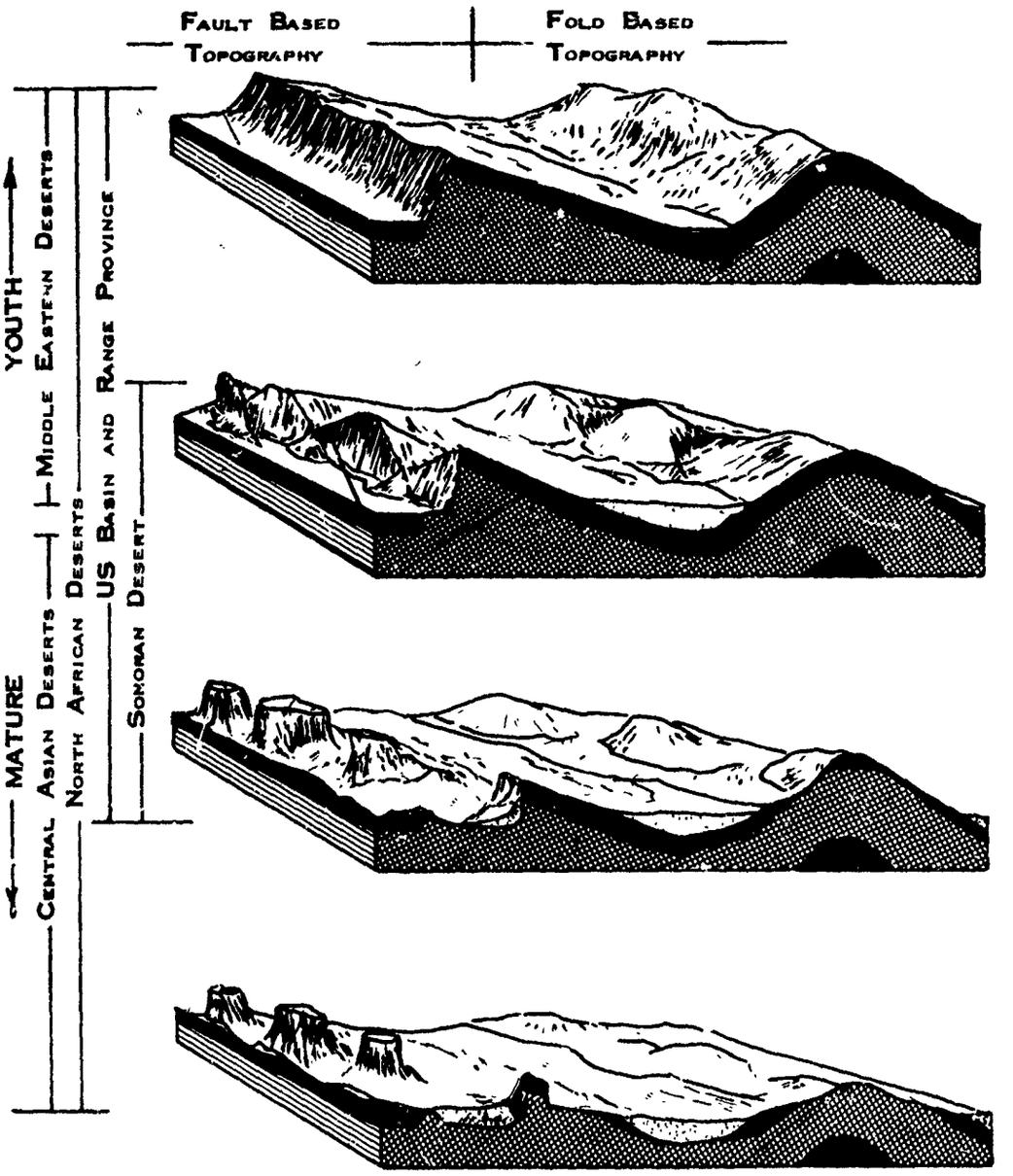

FIGURE STAGES IN THE DEVELOPMENT OF DESERT LANDSCAPES

Figure A-2. Stages in the Development of Desert Landscapes

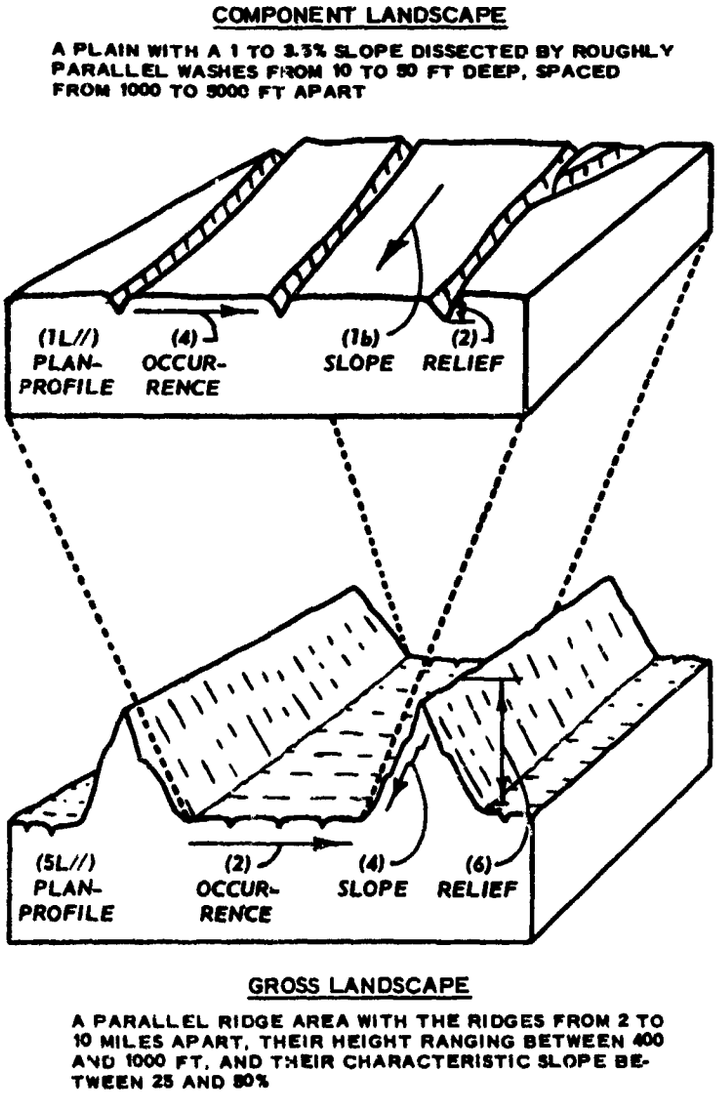

Figure A-3. Landscape Classification System Coding, Waterways Experiment Station Terrain Classification System

CHARACTERISTIC PLAN-PROFILE

The characteristics plan-profile is the most commonly found plan-profile within a region. It may be either gross or restrictive. A gross plan-profile is one that can be subdivided into two restrictive component plan-profiles each exhibiting relief of a lower order than the gross plan-profile. Random sampling with circles 35 miles in diameter is used in determining the gross profile. Random sampling with circles 1 mile in diameter is used to determine the restrictive plan-profile. Local relief of less than 10 feet is not considered.

LEGEND

Highs* Occupy:	Highs are → / Schematic Plan / Schematic Profile	Non-linear and Random	Linear and Random	Non-linear and Parallel	Linear and Parallel
>60% of area	Flat-topped	1	1L**	1//***	1L//
40-60% of area	Flat-topped	2	2L	2//	2L//
<40% of area	Flat-topped	3	3L	3//	3L//
>60% of area	Crested or Peaked	4	4L	4//	4L//
40-60% of area	Crested or Peaked	5	5L	5//	5L//
<40% of area	Crested or Peaked	6	6L	6//	6L//
No pronounced highs or lows		7			

REPRESENTATIVE PLAN-PROFILE

Each of the following block diagrams illustrates a landscape representative of a specific plan-profile type. It should be emphasized that, within the defined limits of each type, a wide variety of landscape configurations are possible.

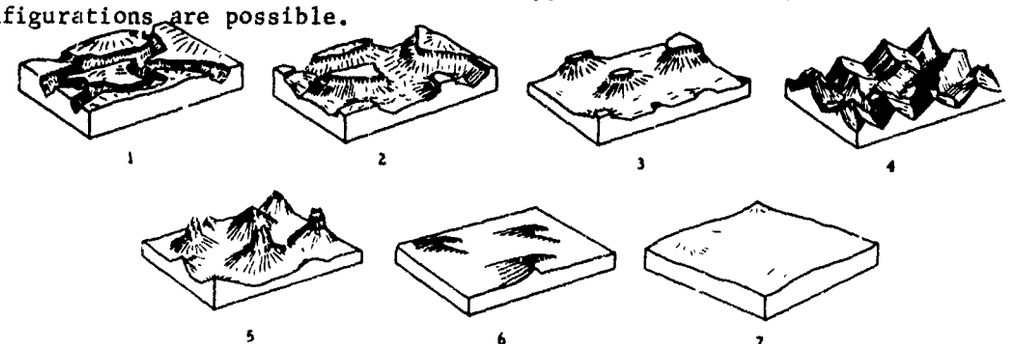

Figure A-4 CHARACTERISTIC PLAN-PROFILE CODINGS

TABLE A-1. Terrain Factor Coding

Factor Code	Slope Occurrence (per 10 miles)						Characteristics Slope (deg)							Characteristic Relief Type 1						Type 2
	1	1 to 5	5 to 20	20 to 100	100 to 200	200	0 to 1/2	1/2 to 2	2 to 6	6 to 14	14 to 26-1/2	26-1/2 to 45	45	0 to 10	10 to 50	50	0 to 100	100 to 400	400 to 1000	Greater Than 1000
1	X	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
1a							X	-	-	-	-	-	-							
1b							-	X	-	-	-	-	-							
2	-	X	-	-	-	-	-	-	X	-	-	-	-	-	X	-	-	-	-	-
3	-	-	X	-	-	-	-	-	-	X	-	-	-	-	-	X	-	-	-	-
4	-	-	-	X	-	-	-	-	-	-	X	-	-	-	-	-	X	-	-	-
5	-	-	-	-	X	-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
6	-	-	-	-	-	X	-	-	-	-	-	-	X	-	-	-	-	-	X	-
7														-	-	-	-	-	-	X